BRILL'S STUDIES IN INTELLECTUAL HISTORY

VOLUME 34

THE LANGUAGE OF SCIENCE

A Study of the Relationship between Literature and Science in the Perspective of a Hermeneutical Ontology

With a Case Study of Darwin's The Origin of Species

BY

ILSE N. BULHOF

E.J. BRILL
LEIDEN • NEW YORK • KÖLN
1992

The paper in this book meets the guidelines for permanence and durability of the Committee on Production Guidelines for Book Longevity of the Council on Library Resources.

Library of Congress Cataloging-in-Publication Data

Bulhof, Ilse Nina.
The language of science: a study of the relationship between literature and science in the perspective of a hermeneutical ontology, with a case study of Darwin's The origin of species / by Ilse N. Bulhof.
p. cm.—(Brill's studies in intellectual history, ISSN 0920-8607; v. 34)
Includes bibliographical references and index.
ISBN 9004096442
1. Literature and science. 2. Darwin, Charles, 1809-1882. On the origin of species. 3. Ontology. 4. Hermeneutics. 5. Science—Philosophy. I. Title. II. Series.
PN55.B77 1992
801—dc20 92-26529
CIP

ISSN 0920-8607
ISBN 90 04 09644 2

PRINTED IN THE NETHERLANDS

CONTENTS

CHAPTER ONE

PURPOSE OF THIS STUDY

This book represents a reflection on the relationship between literature and science and the implication it has for our conceptions of what is commonly called reality and nature. In modern times — roughly from the beginning of the seventeenth century — science, especially the natural sciences, began to adopt an a-literary, indeed an anti-literary, posture. There was actually an anti-rhetorical tendency as well. Scientific writers have been continually encouraged to present the results of their work plainly and unequivocally. Rhetorical and poetical language was to be avoided. Exactitude and brevity were to be the keywords for scientific writings, non-functional ornamentation was to be eschewed.

Thomas Sprat, writing in his *History of the Royal Society* (founded in 1663, the first society for experimental scientific research in West-European culture), related that its members were determined to reject all the amplifications, digressions, and swellings of style:

> to return back to the primitive purity, and shortness, when men delivered so many things, almost in an equal number of words.

Sprat went on to say that the members of the society had required of all their colleagues

> A close naked, natural way of speaking: positive expressions; clear senses; a native easiness: bringing all things as near the Mathematical plainness, as they can.[1]

He gave an especially stern warning against the use of metaphor.

Philosophers such as René Descartes, John Locke and Immanuel Kant agreed that scientific research on the one hand, and literature and the humanities on the other, were two completely different disciplines, and so concomitantly, were scientific and literary writings.

In the eighteenth century 'literary' texts even became a category per se. As their appeal to the emotions, their metaphors and images, and their fictional content increased, they became even more 'literary' in

[1] Quoted by R.D. Romanyshyn (1982, p.175). See also P. Rossi (1970, p.122).

comparison with scientific texts, until eventually, in the romantic period, they came to be something very special: Literature.

An opposing tendency can be observed in the field of science where the interest in language was lost. In scientific writings style was neglected, and natural science became more and more what it is today: conducting research. On the face of it research has nothing to do with literary language and very little with language in general. If science concerns itself with language at all, it seems to do so only at the very end, in the closing phase of the research, when results have to be recorded and justified. Even then, the language used seems only of secondary importance.

In Antiquity and medieval times more respect was accorded to language by those working in the scientific field (most philosophy and theology). According to it the ancient metaphysical *Weltanschauung* it was believed that the structure of reality and of thought were so closely allied that they were interchangeable. A *logical* statement — not only a matter of thinking but also of linguistics — was automatically a *true* statement of reality. Since such a statement happened to be true, it did not need to be subjected to experimental testing. However, in modern times it was realized for the first time that trust in the accord between reality and thinking was based on a grossly exaggerated notion of the scope of human reason. In order to discover whether a logical statement (i.e. the logical language) was really true (i.e. agreed with reality), the statement should be tested against empirical reality in an experiment. The emphasis on the physical experiment is characteristic of modern science. Later again it was realized that even this approach overrated the importance of thinking: from the outset research should be directed by experiments, albeit that experimental action — like any action — required the support of logical thought.

Even though people in Antiquity and the Middle Ages were more language-conscious in connection with science, that language was limited in scope, being exclusively logical. In retrospect it would seem that even in those days logic as developed by Aristotle — the logical connection of statements — was only vaguely connected with language as we understand the word: who would think of language when dealing with logic? It was thus no mere coincidence that linguistic awareness disappeared from modern science.

In the seventeenth century Galilei Galileo and others threw Aristotelian physics and Aristotelian logic overboard as far as the natural sciences were concerned. The researcher was expected to look at matters themselves instead of at the works of Aristotle. New empirical research had no room for Aristotelian reasoning. The

influence of humanism had injected fresh life into classical rhetoric — also a field developed by Aristotle. But when experimental scientific research took off in the seventeenth century, resistance (as recorded by witnesses such as Sprat) arose to the rhetorical manner of speaking, especially in so far as it had penetrated the natural sciences.

In modern and contemporary science language actually plays a subordinate role. Language does have a place, but it must be well disciplined, obedient and modest, almost unnoticeable; the reader has to try hard to catch even a glimpse of it. To give but one example: the meaning of words in science is preferably seen as a question of definition, of agreement, of 'convention'. Words should say what we want them to say. That is how words are dealt with in science. Words are trained to follow reality as we assume it to be through research; words are inexorably assigned their place, their meaning, their limits. Above all, words may never be ambiguous, nor may they evoke associations to stimulate the reader's imagination. The literary theorist Roman Ingarden explains that if the reader of scientific writings notices the language — for example, because a passage is unclear and the reader stumbles, as it were, over the language, — he has to try to 'look around' the obstacle to the world outside the text. A philosopher of science such as Sir Karl R. Popper may realize the important part played by argumentation and critical discussion in science, and even admit that language is then an indispensable medium, but he is only considering the impoverished language of observation and logical thinking.

The anti-rhetorical and anti-literary attitude of modern science has made scientific researchers and philosophers of science by and large forget that the elaboration and formulation of their theories, the discussion, publication and communication of the results of their research are all connected with language; that their language still remains *language* and, in many cases, even *rhetorical-literary* language. Rhetorical-literary language means language characterized by a skilful use of persuasive (rhetorical) and poetic characteristics of language, thereby transcending the mere reporting of facts and the transfer of information.

If we come across a scientific work like Darwin's *The Origin of Species*, we will realize to our amazement that the book is exceptionally 'literary'. Darwin does not bluntly set forth his theory about the origin of species, but whenever he mentions a single living creature he cannot refrain from exclaiming how beautiful it is. He tells what a great researcher he is. He addresses himself directly to his readers in many ways: asking them to pass judgement, flattering them, talking to them,

asking rhetorical questions. He argues in favour of his proposition, but rhetorically rather than logically. He slips in amusing anecdotes, uses poetic images and wonderful comparisons. In order to explain his meaning, he personifies realities like nature and the struggle for existence in wondrous ways. In the case of Darwin, the clear-cut distinction between science on the one hand and rhetoric and literature on the other, so familiar to us, has disappeared. And yet because of its subject matter, this work is regarded a scientific book.

Darwin does not offer us a straightforward, unadorned scientific exposition of his theory about the origin of species. Anyone becoming aware of the literary power of the work must wonder why Darwin writes in such a rhetorical and literary manner. Did Darwin just *happen* to be a great writer? Or will it perhaps be possible to distinguish similar rhetorical and literary elements in *all* scientific texts once we start looking carefully? Could it be that our set notions on science (and literature) are too limited and should be changed? These philosophical questions I will tackle after first taking a close look at Darwin's scientific text with the eyes of a humanist – cultural historian interested in literary theory and in the history and philosophy of science.

In order to throw some light on the text of *The Origin of Species* I have made use of the letters and the fragments of Darwin's autobiography published by Francis Darwin. Of course, much more material is available,[2] but for the time being this seemed sufficient. My intention is not to make this study into an exhaustive examination of Darwin's use of language; one of the goals of this study is rather to create an awareness of the importance of style for scientific thinking. The next chapter, 'Darwin's *Origin of Species*: a rhetorical text', serves as a starting point. In chapter three the widely diverging interpretations the text received are analyzed; it is pointed out that neither this variety in interpretation or the phenomenal success of *The Origin of Species* have till very recently never been connected with its rhetorical-literary language.

The conclusion of my investigations of Darwin's style is that Darwin's work is a wonderful example of the power of language, power even over science. Darwin succeeded by superb literary means in making a metaphor work (natural selection). Once we recognize this, we may have to revise our ideas as to what 'science' and 'literature'

[2] See bibliography.

really are; and perhaps, to revise our notion of 'reality' as well. Let me explain.

These days, the common notion of a reality existing separately from human beings, a reality studied and laid bare by scientific researchers as representatives of humanity — is challenged. This is partly the result of developments in the scientific world itself (discovery of quantum physics, the study of dissipative structures), partly of developments in the philosophy of science (accelerated since the publication in 1962 of Thomas S. Kuhn's *The structure of scientific revolutions)*. These changes in our ideas of reality and science are stimulated by a novel interest in the language used in scientific writings. A seminal study in this area has been *Laboratory Life: The social construction of scientific facts*, by Bruno Latour and Steve Woolgar (1979). In the same year, Paul Feyerabend published his *Against Method*, in which he drew attention to the importance of rhetorical persuasion in Galileo's texts.

Galileo and the Art of Reasoning (1980), Maurice A. Finocchiaro, philosopher of science at Boston University in the United States, has focused attention on the argumentation used in Galileo's famous *Dialogue on the two worlds*, and came to the conclusion that rhetoric has a part to play in science. Other studies to be mentioned in this context are J. Gusfield (1976), Gillian Beer (1983, 1984), Karin D. Knorr-Cetina (1981), Gyorgy Marcus (1987), Steven Shapin (1984, 1988), J.A. Campbell (1987), John R. Nelson a.o. (ed) (1987). The startling way in which the French philosopher Jacques Derrida has used his deconstruction method on philosophical and other texts by dissecting them as texts *per se*, has greatly contributed to making philosophers, in particular philosophers of science, realize the fundamental role of language. In this respect Friedrich Wilhelm Nietzsche was the great and early pioneer and I myself owe much to him in this respect.

I was particularly impressed by Nietzsche seeing a connection between the type of language people speak (literary or scientific, for instance) and the concept of reality (ontology) connected with that language (for example, flowing and dynamic or clear-cut and static). In the field of philosophy Martin Heidegger, Hans-Georg Gadamer and Maurice M. Merleau-Ponty have followed Nietzsche's interest in language and ontology. Philosophers of science, on the other hand, who study the matter of language in science, tend to keep a safe distance from questions of ontology.

To have sounded the possibility of an ontological explanation for the often 'literary' face of innovative scientific writings, and to experiment with a hermeneutical ontology which takes into account

the creative power of language and which calls for a more respectful attitude toward nature or reality than is possible in the framework of the various strands of contemporary 'social construction of reality' philosophies I would like to consider my contribution to the issue. I feel encouraged in my attempts to articulate a plea for hermeneutical ontology by recent work of philosophers of experiment, as e.g. Ian Hacking.

Let me make at this point a preliminary remark about terminology. What do I mean when I use in this study the words 'reality' and 'nature'? Reality is a term loaded with a noble philosophical past, 'real reality' being the unchanging substrate of 'phenomenal reality', or in the modern period, that what could be observed as opposed to merely thought or imagined. This reality taken as a whole was studied by metaphysics, its regions by ontology. Nowadays metaphysics and ontology are in disrepute. The word reality has, however, lost nothing of its emotional appeal: it serves as a battle-cry in scientific and political discourse: objective reality is invoked against man-made subjective fictions and imaginations. In this study I use the word reality in a pre-philosophical, colloquial and vague sense, meaning 'what (in our eyes of course) exists', 'what is'.

The situation around the word nature is equally complicated. 'Nature' figures prominently in the discourse of environmentalists, conservationists and biologists, but also in that of feminists and religious thinkers; surprisingly perhaps it does not figure as such in natural science discourse, although is of course implied in the term natural science meaning the science of nature. Originally, nature meant reality not made by man. 'Nature' used in the scientific sense often comes close to 'reality'. In current discourses we may distinguish between the word as used by 'romantics' (meaning mostly living nature, nature as an object of love and respect) and as implied in scientific discourse (meaning the object scientific research). In this study I use 'nature' in both the romantic and the scientific sense.

My preference for using these words in a rather loose manner stems from the fact that in this way a broad spectrum of meanings is preserved, even to the extent that the words sometimes seem to overlap: such overlaps hint at the existence of continuities that a strict separation of meaning pulls apart.

Concealed behind the way in which we learn to look at science (science as the guardian of 'the' truth about 'the' reality) and learn to approach scientific writings (as if they were completely different from literary writings), there is the sometimes unconscious, but also sometimes very conscious intention of upholding the idea that the

reality studied by the natural sciences has nothing to do with us, people. The recommendation that we should ignore the language of scientific texts is inspired by fear of realizing that imagination and dream also have a part to play in the constitution of what we call reality. Innovative scientific researchers are sensitive to the abundance of possibilities offered by reality — a reality that will not allow itself to be straight-jacketed into scientific definitions or any other fixed principles. This sensitivity is expressed in their literary use of language. By paying attention to the literary elements in scientific writings, we may realize that the world we live in still has possibilities on offer, is mysterious and full of fascinating possibilities — and will remain so.

We experience ourselves and the world through language — through words, images, concepts and grammatical structures. Hence we also change the world in which we are placed by changing the language which we speak. A world in which words like 'productivity' and 'discourse' are in current use is different from a world in which 'heretics' and 'mercy' are part of the general vocabulary. We are not only born into reality but also into a language — not a language that we have chosen ourselves. The language we happen to learn to speak, our mother tongue, presents reality to us in its own particular way. It also enables us to put our experiences into words and to move in the world in a certain way. But it also leaves aspects of reality unnamed, leaves them in the dark, as it were. With their words, their images, their concepts and their structures our human languages place a spell on reality, a spell which can, indeed, be broken over and over again, only to re-appear in the form of new words — a new spell. This applies not only to social and cultural reality but also to that reality which we use to call 'nature'.

It has been said that we, modern people in the West, live in a world disenchanted by science. By closely observing the game that an author such as Darwin plays with language, and language with Darwin, one gradually realizes that scientific language in its turn casts a spell on natural reality. The scientific exposés would have us believe that reality is rational and comprehensible, a phenomenon existing outside ourselves, but recognizable and cognizable. It would appear that suddenly in the seventeenth century we, humans, came face to face with 'reality', with 'truth' for the first time and that, thanks to the natural sciences we could be forever freed from all spells. But ... could this so-called disenchanting of the world not merely be the effect of one of the most powerful magic formulae known to the world?

This can be a liberating conclusion: science loses its claim — now and in the future — on possessing 'the' truth (a claim which,

incidentally, is being increasingly relinquished by science itself, though it still finds many defenders in our culture); other experiences of reality and other worlds in which to live are apparently possible. But there is also something of a *threat*: our democratic culture is, to a large extent, founded on the belief in a reality that exists separately from us, acting as a *touchstone* for the truth or falsehood of our ideas. The disappearance of that touchstone presents us with social, philosophical and ethical problems that cannot immediately be solved. How would it be to live *without* the founding notion of modern culture that an objective reality exists, separately from humanity, the traditional object of scientific study? And *without* the idea that everything, from objects to complexes of things, processes and relationships, is exactly 'as it is in itself' so that it can be defined and expressed in exact and precise language? How it would be to notice that what we call reality is, in fact, richly faceted, full of possible meanings or *polysemic*, and therefore 'enchanting'? Could that imply that scientific researchers in each historical period and in each culture only select and highlight certain facets, aspects and meanings of that richness? That perhaps the way we deal with reality or 'nature' resembles the *reading* and interpretation of a literary text? Moreover, could this conception of a polysemic reality and of our dealings with it perhaps bring ethics back into science — by paying attention to the ethical impact of metaphors in science?

I try to respond to these questions by developing a *hermeneutical ontology*. The metaphor of reading and interpreting, and the old notion of reading the book of nature, serve as heuristic means to rethink the modern view of the relation between man and nature or reality as a relation between an active researching subject and a passive researched object. This metaphor suggests that natural reality could be regarded as a *structure of possibilities* which could provide support for different interpretations, and as a result, for different concretizations and realizations of natural reality in the world in which we live. I will argue that the literary elements found in innovative scientific texts might bear witness to the writers'/researchers' openness to the polysemic reality of nature — a reality which is not once and for all 'what it is' in a univocal manner, but is multivocal like a literary text, coming to be in interactions with its readers.

Thus it may be stated that this study fits several contexts: first of all attempts by philosophers and sociologists of science to point out the role of scientific language in shaping scientific knowledge, arguing that 'nature' and 'reality' are social constructs. But it fits equally the other context: of attempts in hermeneutical philosophy to overcome

the subject-object split; attempts which draw their inspiration from the thought of Nietzsche, Martin Heidegger, and Merleau–Ponty. Philosophers standing in this tradition resist a sociology of science run wild in which the object of study, reality or nature, has all but disappeared from view, or figures as unformed matter ('material') to be used by man, or even as a rest-category to be removed by science and technology. Finally, this study fits in an implicite manner the context of feminist protests against the modern approach of a female slave-like nature by a male master.

In chapter one attention is drawn to the amazing rhetorical an poetical aspects of *The Origin of Species*, to begin with its 'introduction'. I would suggest that the scientific revolution brought about by Darwin was, in fact, the accomplishment by the author's literary skills.
Before analyzing, in chapter four, the literary strategies used by Darwin to accomplish this feat (use of metaphors, similes, personifications; reminiscences of various literary genres, appeal to the readers' experiences, courteous relationship to his readership, his manner of argumentation), the reader is introduced in chapter three to the scientific issues confronting the natural historians of the time, and to Darwin's solution to them. The discoveries of innumerable newly found species and the fossils of species long since extinct were baffling. This made people wonder whether God had really created them all. Darwin's solution was his theory of natural selection — a theory that had no need for divine intervention. I have used the development in The Netherlands as an example to illustrate what happened elsewhere before and after the publication of Darwin's book. In being persuaded to accept Darwin's theory very few people were aware of the effectiveness of the theory's textual vehicle.

Chapter five deals with several questions: why people lost the habit of reading scientific texts as texts, the role of nominalism in this process; how the language arts, on the one hand logic, on the other hand rhetoric and poetry, were ousted from science and 'doing science' came to mean 'doing research'; and why in the face of so much evidence to the contrary there is so much resistance to the acknowledgement of the creatively mediating role of language in science.

Finally, in chapter six, the question of why language can be such a creative mediating factor in science is tackled from an ontological point of view. Here I have explained the fruitfulness of the hermeneutical-rhetorical tradition and introduce my proposal for a hermeneutical ontology in which the interpretation of nature is compared with to the

interpretation of a literary text — text as contemporary literary theory conceives of it. I suggest that nature might be considered a possibility-state which can be 'concretized' or 'materialized' in several ways.
To the conclusion, in chapter seven, a brief Postscript is added in which contemporary investigations are referred to, which may lead into the same direction.

This study is the result of the interaction with written texts — I have already mentioned some authors that have been important to me — but also of extensive discussions with colleagues and friends. With pleasure and gratitude I would like to mention my closest colleagues Th.H. (Theo) Zweerman and H.A.M. (Henk) Manschot. Their interest proved a great stimulus. The meetings with A. Vos were very stimulating. In this respect I would also like to mention the group of philosophers of science at the University of Groningen, especially L.W. (Lolle) Nauta, with whom I first discussed the thoughts expressed in this book. I am very glad to have come into contact with the philosophers of science in Utrecht as well. I am especially grateful to J.A. (Joop) Schopman for reading the Dutch version of the manuscript and making extensive comments on it. I am grateful to M. (Maarten) van Buuren, and T. van der Meulen–Kooistra for commenting on my manuscript and to J.M.M. (Koos) de Valk and H. Achterhuis for their helpful comments on the published Dutch version. I particularly enjoyed the stimulating conversations with R.D. (Bob) Romanyshyn at the time at the University of Dallas, Dallas, Texas. I am very grateful to the Department of Germanic Languages of The University of Texas at Austin, U.S.A., for having invited me as a Visiting Scholar during the Spring Semester of 1991. Preparing my lectures, the use of U.T. Library facilities and the spirited discussions with colleagues have been of great value to me in preparing the English expanded edition of this book. Ina Davids, read the final version of the Dutch manuscript and gave much useful stylistic advice — many thanks to her too. Lysbeth Croiset van Uchelen–Brouwer completely revised the first draft of the English translation and Ann J. Williams kindly checked the final version, for which I am very grateful indeed. The enthusiasm of Martin and Lucienne Reinders in making the manuscript camera ready has been a great help to me. Anna M.G. Vuister was an important sounding board throughout the whole writing process, thanks to her intuitive gifts; I include her name with pleasure in this list.

CHAPTER TWO

DARWIN'S *THE ORIGIN OF SPECIES*: A RHETORICAL TEXT

2.1 THE INTRODUCTION

When on board HMS Beagle as naturalist — these are the opening words of Darwin's *The Origin of Species* in which he gives an account of his voyage of discovery around the world, including South America.

He travelled as naturalist on board the warship HMS Beagle. His brief was to collect world-wide information on the natural world — on the flora and the fauna, but also on mountains, rivers and landscapes. At the beginning of the nineteenth century, large areas of nature — flora, fauna, landscapes — were still 'undiscovered', that is they had not yet been studied and described by Western scientists, they were not yet accessible to the Western world. The study of nature (or natural history) at the time consisted of description and classification according to species.

Plants and animals found in foreign parts could be seen, could be observed. These visible facts,[1] however, pointed to an underlying and mysterious reality that could not simply be observed: the *origin* of the different species. Darwin was intrigued by this problem:

> When on board HMS 'Beagle' as naturalist, I was much struck with certain facts in the distribution of the organic beings inhabiting South America, and in the geological relations of the present to the past inhabitants of that continent. [Darwin is referring to the fact that in older geological strata the forms of life were decidedly different from, and yet appear to be related to, each other.] These facts, as will be seen in the latter chapters of this volume, seemed to throw some light on the origin of species – that mystery of mysteries, as it has been called by one of our greatest philosophers.(27)[2]

[1] The word 'fact' is a loaded term for a philosopher of science: when closely examined, a fact does not exist separately from a theory. In this study I have used the word 'fact' as is common in ordinary language: as a phenomenon which everyone can perceive; a fact of this type is regarded as 'true'.

[2] Edition used: Charles Darwin: *On the Origin of Species by means of Natural Selection or the Preservation of Favoured Races in the Struggle for Life* (1958A). This edition is based on the last edition supervised by Darwin himself (the sixth) and has an Introduction written by Sir J. Huxley. The numbers included in the text refer to this edition.

Mystery of mysteries — what sort of book are we dealing with? Is it a work of science, a detective story, a novel, or a profound philosophical or esoteric work? Darwin had found the expression in a letter written by the astronomer Sir John Frederick Herschel, who used the words in connection with wondrous facts recently uncovered: the coming into existence of new species and the extinction of old ones in the course of time. In his notes dated 2 December 1838 Darwin wrote that Herschel had written a very good passage about this incomprehensible phenomenon, a passage showing that he believed that there could be something like intermediate causes for this phenomenon. The idea appealed to Darwin. *Hurray - intermediate causes*, he exclaimed.[3] There was no doubt in the minds of most people, including Darwin, that the first cause of everything is God. But did God continually intervene at the emergence of every new species? Why did all the animals that God had wished create not continue to exist? The newly acquired knowledge of geology, flora, and fauna gave people the impression that they were faced with an enormous puzzle, a mystery. The notion of God's continual intervention clashed with the idea of nature as an independently functioning entity, and this clash only grew greater with each new species discovered.[4] When Darwin was brought into contact with the incredible richness of the world's fauna during his voyage, he too, was gripped by the mystery. This feeling of wonder stayed with him for the rest of his life, and on his return home he resolved to find out more about it:

> On my return home, it occurred to me, in 1837, that something might perhaps be made out on this question by patiently accumulating and reflecting on all sorts of facts which could possibly have any bearing on it.(27)

In the course of five years of disciplined work Darwin limited himself to the mere collection of facts. Only then did he finally allow himself to engage in speculation on the subject, and by reflection to attempt placing the facts he had found in a wider explanatory framework. His conclusions were written up in a short report — a kind of abstract — in 1844. From that moment, up to the time when he began work on *The Origin of Species* (1859) he continued to strive for the same goal:

[3] Quoted by G. Pickering (1974, p.86).
[4] L. Eiseley (1970; 1958).

that of finding the explanatory framework. This is also apparent from his autobiography and the notes about him left by his son Francis.[5]

Darwin lived with his family far from London on a remote estate which he seldom left and where very few visitors ever came. Thanks to his wife's fortune he had no financial worries. In this quiet, rural setting he was able to work on his research project day in, day out. *The Origin of Species* was the result of twenty years' unremitting labour.

Why did Darwin provide us with such personal details in the introduction to his book? Surely it is irrelevant whether he took two or twenty years over his work? What do such particulars of his private life matter to such a project? Surely science is about results obtained rather than the way leading to those results? Was he vain? On the contrary. Darwin did not consider himself to be in the least important and even apologized for these references to himself: *I hope that you will excuse me for entering into personal details.* His only reason for the personal touch is to show that he had not taken his decision on the true origin of species in haste.

Darwin wished to make clear that he was a trustworthy guide for the difficult subject matter of the origin of species: that, however bold the book's contents might appear, he had not thought it up overnight; that the solution he proposed to the mystery of mysteries was not an affair of unbridled imagination, nor of sudden inspiration or careless thought processes, but of patient, quiet pure research.

Facts before theory: take nothing for granted, do all research yourself, work hard — that is the stuff scientific research is made of. Thus Darwin established in the very first pages of *The Origin of Species* his authority as researcher and, at the same time, as writer: the narrative first person (*When on board HMS Beagle, as naturalist (...)*) is both writer and researcher. The author of the book is a *pur sang* researcher. Simultaneously, however, the researcher is a *pur sang* author, as the reader will realize more and more clearly.

Darwin, in his own words, based his determination, his *decision* about the origin of species on many years of hard work. Let us examine the full impact of the word *decision*. What does it mean when he said that his conclusions required a determination, a decision? A logical conclusion, we are wont to say, is the natural and necessary result of the premises preceding it. A decision, however, assumes a leap; out of many possibilities one is chosen — a decision does not follow inevitably, necessarily, from what has preceded it. It requires a

[5] Ch. Darwin (1958c).

leap, an act of will. A gap is bridged. A decision marks a moment in time. It separates a 'before' (a time of insecurity and obscurity) from an 'after' (a time of security and clarity). A decision requires courage. It always harbours the risk of making the wrong choice, with subsequent negative results.

If the decision concerns a scientific problem, questions inevitably arise, such as: Was the leap to bridge the gap, the decision, justified? What is the difference between a determination in the sense of a logical conclusion and a determination in the sense of a decision? Normally, when we speak, we just don't think about it. *Decision* is a word with more than one meaning. The reader must interpret its meaning from the relevant context. But sometimes the use of such a word actually dominates the context and endows it with a particular colour — which would seem to be the case here. When does science deal with logical conclusions, when with decisions? Whatever the answer may be, it is clear that Darwin felt he had taken a decision. And of course he believed that his decision was justified: had he not worked so long and so hard at the problem for that very reason?

In all those years he had collected so much material, that he was unable to place more than a tiny portion of it in his book. In *The Origin of Species* he only indicates the main lines of his research:

> I can here give only the general conclusions at which I have arrived, with a few facts in illustration, but which, I hope, in most cases will suffice.(27-28)

The Origin of Species, extensive though it may be, is no more than an *abstract*. Darwin hoped to be able to publish all the material he had to omit from his book at a later date:

> No one can feel more sensible than I do of the necessity of hereafter publishing in detail all the facts, with references, on which my conclusions have been grounded; and I hope in a future work to do this.(28)

Hence Darwin's statement that *The Origin of Species* was almost complete, although his own work was far from being finished.

Why then, did he publish the book when he did? In the first place, as he himself said in the introduction, he was not a healthy man. It was therefore possible that he might not be able to complete his life's work. His autobiography does in fact tell us that Darwin often suffered from stomach trouble and was subject to headaches. His bad health was one of the reasons that kept him at home. Or was it an excuse to avoid having to go out? That is George Pickering's opinion, who was surprised that a man who took part in a round-the-world trip lasting many years, with regular expeditions entailing long walks and hunting

or shooting trips on land, and who was therefore quite clearly as sound as a bell, should suddenly turn into a sickly man on his return home. Pickering suggested that Darwin developed his complaints so as not to be distracted from his life's work.[6]

In addition to his weak health Darwin gave a second reason, and undoubtedly a much weightier one: another researcher, Alfred Russell Wallace, had published his writings on the same subject at the same time and had come to more or less the same conclusions as Darwin.[7] Two of his friends, the geologist Charles Lyell and the botanist Joseph Dalton Hooker, therefore advised Darwin to publish his ideas at the same time as Wallace's article.

It is remarkable that two researchers who did not even know of each other's existence should be studying the same subject and making the same discoveries. But it does, in fact happen, quite frequently that the same discovery is made several times. One example is the invention of the art of printing in Holland and in Germany in the fifteenth century; another the discovery of the unconscious by Sigmund Freud and many others in our time. Were such discoveries just hanging about, waiting to be made? Was there a cultural climate in which they spontaneously crystallized?

However that may be, because of the circumstances outlined above, publication was to some extent premature and as a result the book was inevitably less than perfect. For one thing Darwin did not include references or sources, as is customary in a scientific work. He asked the readers to trust in the accuracy of the factual material he used and of the opinions of others which he quoted.

Darwin's admission that the book was not perfect evokes a sympathetic ear. These are the words of the true researcher: my work is not finished, please forgive me. Let him be forgiven, bad health is always a valid reason, and everyone will understand the unspoken, underlying reason: that he would gladly — and deservedly — have his name associated with the unravelling of a mystery as great as that of the diversity of species, together with Wallace's.

But what precisely is the imperfection of this 'abstract', this *Origin of Species* we have before us? Would it be possible to add to the text the missing references and sources which Darwin did not manage to include in 1859 at a later date (for instance in a new edition) or perhaps to publish them in separate publications? Can the main lines

[6] G. Pickering (1974).

[7] J.H. van den Berg (1984, pp.20-25); F.M. Turner (1974, pp.68-103).

he set out in the book be supported by the extra material he said to have at his disposal? The whole affair is much more complicated than that.

Darwin was well aware that the reason why his work was not perfect was *not* only its incompleteness; there was a more fundamental reason. He realized very well it would be difficult to find in his book one issue that could not be disputed by facts pointing to diametrically opposed conclusions. But here again Darwin presented himself as the honest researcher: he candidly admitted that others might arrive at conclusions contradictory to his own. He did not wish to force matters, nor to impose his views on others. He had no desire to pull the wool over people's eyes. The reader may be assured that *his* facts, the facts that *he* advanced, were accurate. He did not deny that apparently there were other facts, just as hard as his own, which did not agree with his solution to the riddle of the species. But ... what if these other facts were to be chosen to serve as basis for the argument? Would that not lead to completely different conclusions? It most certainly would. And so we begin to understand why Darwin spoke of a *decision*: he has not managed to untie the knot of the origin of species but resolutely, with great decisiveness, has cut that knot by basing himself on one set of facts while rejecting another. Of course, he believed that he had good reasons for that choice, and in his book he has laid out these grounds for the reader's perusal, together with the ensuing *decision*.

The purpose of his book he stated, was to encourage discussion of the problem, for any debate about a controversial subject requires an *audi et alteram partem*.

> A fair result can be obtained only by fully stating and balancing the facts and arguments on both sides of each question.(28)

The Origin of Species was but *one* voice in the debate concerning the origin of species. The outcome of the debate raging among biologists and other scientists, especially geologists, was still uncertain. The origin as seen by Darwin had not been scientifically proved, not even by him, and he was only too well aware of this, *vide* the last paragraph of the introduction:

> (...) much remaining as yet unexplained in regard to the origin of species and varieties (...).
>
> Although much remains obscure, and will long remain obscure.
>
> (...) for our profound ignorance in regard to the mutual relations of the many beings which live around us (...).(30)

The book was launching an opinion, a hypothesis, a supposition. Darwin used his text to show what, in his opinion, lay concealed behind the facts that he had established and what explained these facts: the mechanism of the struggle for existence combined with that of natural selection. He used it to defend his opinion against others on the subject, including one which he himself had supported for a long time: that God had created each species separately. Darwin had now come to the conclusion that this was untenable, an error.

The Origin of Species is part of a running debate, an argumentation. But it is more than that. It is also itself an argumentation from A to Z, *one long argument.*(426) And if that is the case, the book should not only be seen within the framework of biological research (observation, tests, recording the outcome; renewed observation, tests, recording, and so on) but also within that of argumentation theory.

Argumentation and discussion are necessary whenever we are faced with matters that are uncertain. Argumentation and discussion have long had their niche in practical philosophy, political philosophy and ethics. And yet *The Origin of Species* comes under science. Science has of old been the field in which it is considered possible to discover certain, conclusive knowledge (in contrast, for instance, to ethics and politics). The truths of science had to be proved or 'demonstrated'.

In this light it is remarkable that Darwin does not simply affirm the truth of his decisions or conclusions concerning the origin of species. He uses the word 'fair' — *a fair result* — indicating perhaps rather a compromise or a negotiation, on the basis of which parties have come to an agreement and can now proceed further. The words *a fair result* evoke the connotation of a good sport. Darwin had been fair, had been honest: he had not only stated what he knew, but also what was as yet unknown. In the end he has emerged as winner from the debate. And in addition to the impression of being a good sport, we also sense a man who is still groping in the dark. Nothing was absolutely certain as yet. Had Darwin succeeded in proving his hypothesis? Or had others succeeded? How was consensus as to its correctness — a consensus which was quick to form — replaced by actual proof?

It would, of course, have meant a terrible waste of his energy and labour, over many years, if consensus about the origin of species had turned out to be different from what he had in mind. In an effort to prevent such a waste, Darwin used the first paragraph of *The Origin of Species* to set out a detailed description of his qualities as scientific researcher, thus seeking to obtain the credit which he badly needed in

view of the uncertain nature of his project. In other words, Darwin used these passages to *rhetorical effect.* Indeed, the book as a whole should affect the readers. It should not leave them indifferent, but persuade them to take Darwin's side in the debate on the origin of species. It should therefore be realized that not only the passages quoted are rhetorical (in the sense of persuasive), but that *The Origin of Species per se* is a rhetorical work.

Various biologists had already advanced the opinion that the species had not come into existence separately but were descended from other species.[8] But as long as no exact indication could be given of *how* the species had deviated from earlier types, this idea failed to carry conviction. For, according to Darwin, it was essential that justice be done to the perfection of the structure of living organisms and the miraculous mutual adaptation of this structure to the environment and vice versa. And, in his eyes, such justice had so far not been done. For — and here he grew vehement — in order to explain the miracle, biologists had consistently emphasized the role of external conditions such as climate, nutrition, etc.; these they regarded as the only possible sources of variation. This might be true to a certain extent, but it was *preposterous* to ascribe such a phenomenon merely to external circumstances. Take, for instance, the miraculous form of a woodpecker, with its feet, tail, beak and tongue so wonderfully adapted to catching insects hidden under the bark of trees. This could not have been caused by external factors alone. And it was just as preposterous to attempt explaining the outward appearance of mistletoe exclusively by external factors.

Preposterous. A word filled with passion. Here Darwin was no longer a 'fair' mediator between two or more opinions in order to reach a balanced solution to a problem — no, he was himself passionately involved. By making an emotional appeal based on the miraculously beautiful and efficient structure of natural phenomena, the author was attempting to discredit the simplistic opinions of his opponents and so to disqualify them from the ring of serious speakers. The word *preposterous* creates a mood, tries to win sides. In passing it should be remarked that the judgement Darwin passed on biologists who thought they could explain the origin of the various species on the grounds of external factors was much more severe (*preposterous*) than his judgement on the believers in the separate creation of each species (*erroneous*). This creates the impression that Darwin could more easily

[8] See chapter three, § 1.

accept the fact that some people should appeal to a mysterious creation — a view still reflecting reverent surprise which he himself felt so strongly — than the simple explanation provided by external factors.

The better Darwin's Introduction would succeed in impressing on the reader the importance of the issue of the origin of species (*mystery of mysteries*), in demonstrating the ridiculous nature of the learned scientific solutions put forward so far and the untenable nature of the present state of research, the more urgent would become the search for the real solution. And the more liberating it would be if finally the operative word (*natural selection*) were spoken. In the Introduction, Darwin had skilfully constructed a platform from which to fire his rocket. The explosive it carried was briefly referred to in the final paragraph: the species are not immutable, and natural selection is the most important, if not the only, way in which changes can occur.

2.2 THE EFFECTIVENESS OF *THE ORIGIN OF SPECIES* AS TEXT

Why was natural selection as the solution to the problem of the origin of species suddenly experienced as such a great shock? Why was it so much more shocking than the idea of changes brought about by the mutual adaptation of living creatures and their environment? This discussion had so far caused no heated arguments.[9]

Indeed, when Darwin's presentation of his theory on the origin of species was read at a meeting of the Linnaean Society, together with the contribution submitted by Wallace, nobody reacted. There was not even any ensuing discussion. In his annual report for 1859, the chairman did not even mention the papers.

> The year which has passed (...) has not, he wrote, indeed, been marked by any of those striking discoveries which at once revolutionize the department of science on which they bear.[10]

In 1859, quite clearly, no-one was aware of what everyone seemed to realize some time later: that the world was waiting for Darwin. Darwin's conclusions *acquired* a shock effect by the way he argued and put his conclusions into words, factors which caused the book to be an immediate sensation, with an enormous response from all sides.

The Origin of Species, the written word, achieved what scientific lectures given at the respectable Linnaean Society had never

[9] See chapter three, §§ 1-3.

[10] Quoted by J.H. van den Berg (1984, p.24).

accomplished: a scientific revolution in its purest form. Or, in other words, it was not the theory in itself which caused the revolution but the theory as presented and expressed in *The Origin of Species*. Darwin used his book to tempt his readers to enter a new world. He showed them natural phenomena never previously seen. And once led into this world, his readers could not escape, they could no longer free themselves of what they had read. Darwin's readers and subsequent generations have come to experience the natural world differently because of what he has written. His grandfather, Erasmus Darwin, made a graphic comparison between the change effected by Charles, and the transformation from alchemy to scientific chemistry. Both opened up a new world for mankind.

Nowadays everyone agrees that Darwin's book gave a twist to the culture of his time that could never be untwisted. Henceforth everyone would see nature as he had perceived it: a savage struggle for survival in which the stronger species survive and multiply and the weaker sorts are defeated and become extinct. From Thomas Henry Huxley, one of Darwin's most eloquent defenders, we can see how deep a wound Darwin's vision of the natural world inflicted on his contemporaries.

Nature, according to Huxley, is the chance result of the everlasting struggle for survival. Neither nature nor humanity have any special destination. Therefore mankind cannot claim the right to rule over nature. Mankind can even be brought down from his exalted position at any given moment: man has to wage a continual defensive struggle against the forces of nature, for these constitute a constant threat to the fragile fabric of human culture. Huxley compared the antagonism between man and nature with that between a garden and the surrounding natural habitat. A wall is required to protect the cultivated garden plants from the natural vegetation outside. As soon as the gardener ceases to protect his garden, the accomplishments of cultivation are destroyed by nature. The same applies, according to Huxley, to a *plantation* of people (to use an old-fashioned term for *colony*) in the midst of uncultivated areas in the world. There is a permanent threat of the garden and the population plantation being destroyed by nature. Every world that man builds for himself, every 'civilisation' (to use the term which was gaining currency in the nineteenth century) is an artificial world requiring defence against the inroads of nature.[11]

[11] Th.H. Huxley (1896, p.13).

Huxley compared the arduous struggle between mankind and nature to a game of chess played as a matter of life and death. We are engaged in a game much more complicated than chess:

> It is a game which has been played for untold ages, every man and woman of us being one of the two players in a game of his or her own. The chess-board is the world, the pieces are the phenomena of the universe, the rules of the game are what we call the laws of Nature. The player on the other side is hidden from us. We know that his play is always fair, just and patient. But we also know, to our cost, that he never overlooks a mistake or makes the smallest allowance for ignorance. To the man who plays well, the highest stakes are paid, with the sort of ever-flowing generosity with which the strong shows delight in strength. And one who plays ill is checkmated without haste, but without remorse.[12]

In her struggle for existence, nature shows an exceptional lack of scruples. The cosmos stands accused before the tribunal of cultural and ethical mankind. Huxley even went so far as to call nature *the headquarters of the enemy of ethical nature.*[13]

In order to build a civilisation, Huxley went on to explain, man must not only defend himself against the natural forces outside, but also against the natural forces inside himself. Hidden inside ourselves are still the monkey and the tiger. Since nature will always be with us, we shall always have to fight her.[14]

Echoes of the same despair regarding the 'proven' cruelty of nature can be found in the works of many nineteenth and twentieth century writers. Think of Nietzsche (*Imagine a creature such as nature, endlessly wasteful, endlessly indifferent, without aims, without mercy and justice, at the same time horrifying and barren and uncertain;*[15]) or Freud (We will never be able to master nature outside us and nature within us — *the superior power of nature* outside us and *the feebleness of our own bodies*, or nature within us are two of the three *sources from which our suffering comes*;[16]) and the Dutchman Frederik van Eeden (*It is nonsense to ask if nature has an end. And just as senseless to ask if humanity has one. No daring thinker will ever again maintain that that which exists, has an ethical significance.*[17]) The effect of *The Origin of*

[12] Th.H. Huxley (1898, p.82).
[13] Th.H. Huxley (1896, p.75).
[14] Ibid., p.85.
[15] F.W. Nietzsche (1965, vol.2, pp.572-573).
[16] S. Freud (1962, p.33).
[17] F. van Eeden (1971, vol.1, p.118).

Species was to place man in a hard world in which the survival of the fittest prevailed. With his book Darwin continued spinning the web of words in which the world was expounded and could materialize in a new way.

Not only did *the Origin of Species* sell like hot cakes, the thesis it proposed also met with approval, on the whole. This was precisely what Darwin had hoped for. But it may be obvious that this rapid approval was not so much the outcome of people's own observations, proofs, etc., it was rather the result of Darwin's powers of persuasion. It suddenly seemed as if further discussion was superfluous; as if hypothesis were no longer hypothesis but fact; as if in the case of Darwin — contrary to his predecessors in the field — it was no longer a question of an interesting idea but an irrefutable, proven scientific fact.

Darwin's theory of evolution fared like Galileo's thesis of the Earth revolving around the Sun: what had previously, for instance in the Copernican system, been seen as an interesting idea and an exciting hypothesis, suddenly turned into an established fact, a truth. In the case of Galileo the use of the telescope was of decisive importance. No single authority — the authority of ancient writings, sacred or profane — could equal what Galileo made people see with their eyes, nor to what they, once able to do so, wanted to see with their own eyes. Through his persuasive writings Galileo knew how to let people first of all use their eyes and then to take their own eyes, their own observations, seriously.

In Darwin's case no spectacular device — such as the telescope — was involved in the metamorphosis from hypothesis to fact: the only device was the book itself, even though it was not recognized as such. No authority on earth could prevail against the picture of Darwin's sustained research, his fair way of putting an argument across, and the overwhelming quantity of factual information with which he belaboured his listeners' ears, casually observing that this was but a fraction of the facts at his disposal. Lyell's reaction to the book was typical:

> It is a splendid case of close reasoning, and long substantial argument throughout so many pages; the condensation immense.[18]

As will be shown in the next chapter, *The Origin of Species* has at the time been interpreted in many different and often contradictory ways. Some considered it an excessively speculative work of fantasy while

[18] Ch. Darwin (1958c, pp.218-219).

others (fortunately for Darwin the majority) regarded it as a paragon of scientific procedure. Still others felt that it supported their belief in the one Creator, while others jumped at it as the decisive proof that there was no question of a creation but that nature as we know it sprang from mechanical processes. What did Darwin actually want to express? What is *The Origin of Species'* message, and what did its readers make of it? Where do all the interpretations come from? Did everyone read into it what he or she wished to read? Was Darwin's language unclear? Or is language as such playing tricks on us here?

Against the background of the overwhelming success of the book,[19] it is touching to realize that Darwin was far from reassured about the way in which his brainchild would be received by his colleagues and the general public. He was concerned that he would not be taken seriously, that people would, for instance, think that he was indulging in too much speculation, that he had drawn his conclusions too hastily and that the evidence was still insufficient. Hence his gratitude to Lyell who had introduced the book at a scientific meeting in such a way that it would be given a fair chance to be studied seriously instead of being immediately put down as ridiculous.[20]

In fact, Darwin himself was not sure whether he had been carried away by his imagination. The very thought made shivers run down his spine:

> Thinking of so many cases of men pursuing an illusion for years, often and often a cold shudder has run through me, and I have asked myself whether I may not have devoted my life to a phantasy.[21]
>
> I had awful misgivings; and thought perhaps I had deluded myself, like so many have done.[22]

In other words: Darwin was not sure whether his hypothesis was not merely an imaginative story, a 'novel' in the present sense of the word. And if he himself could not say whether the book took him to the land of fact or of fiction, one can easily understand his uncertainty as to how the public would react. Only the reactions of his readers, notably Lyell, Hooker and Huxley — three learned men whom he had chosen as 'judges' and whose judgement he had decided to accept — set

[19] See p.49 of this study.
[20] Ch. Darwin (1958c), p.214.
[21] Ibid., p.225.
[22] Ibid., p.227.

his mind at rest. His colleagues' approval convinced him that his hypothesis, was, indeed, concerned with reality; that he was no fantast, no writer of novels; that he was not out of his mind. By responding positively to *The Origin of Species* its *readers* contributed considerably to its premises being unconditionally accepted as true. Any hesitation Darwin might have felt before publication of his book was swept away by the overwhelming acclaim with which it was greeted. Unawares he was led by his readers to regard his own hypothesis as the truth. Both Darwin and the public seemed to have forgotten the hypothetical character of his views.

Before examining the actual text, a closer look at the scientific issues of *The Origin of Species* as well as their scientific and cultural context would seem appropriate. I would like to do so by presenting a case study: the reception of *The Origin of Species* in The Netherlands. What happened in The Netherlands in the years around 1859 exemplifies what was going on in other countries as well — the general puzzlement of biologists about the origin of species, the overwhelming impression *The Origin of Species* made, the wide spectrum of interpretations that were proposed and the ways 'Darwinism' was exploited by various social groups.[23] Therefore the following section, 'The scientific debate on the origin of species in The Netherlands', can be read as background information on the 'mystery of mysteries' for the reader who is not familiar with Darwin's evolution theory.[24]

[23] Th.F. Glick (ed.) (1974).

[24] A useful and more extensive general introduction is L. Eiseley (1961).

CHAPTER THREE

THE ENIGMA OF *THE ORIGIN OF SPECIES*

3.1 THE SCIENTIFIC DEBATE ON THE ORIGIN OF SPECIES: THE NETHERLANDS

The origin of species had been the subject of extensive scientific discussions for quite some time when Darwin published his book on the subject. Three major discoveries had activated the debate: the discovery by geologists that the world was much older than had so far been assumed on the basis of biblical evidence;[1] the discovery by naturalists that there were many different species, especially in other continents — a discovery which did not fit the picture of the species as painted by Carolus Linnaeus in the eighteenth century; and finally the discovery by palaeontologists of fossilized plant and animal remains, remains which seemed to have belonged to such strange creatures that classification was extremely difficult. How could these revolutionary ideas be coped with? How could they, for instance, be reconciled with the story of creation as told in Genesis? How had living creatures come into existence?

In the first half of the nineteenth century attention to morphological resemblance between groups of animals had caused naturalists to see certain groups of animals as related. But the connections were viewed by most students of nature as divinely ordained. When during the same period geologists discovered a succession of faunas in geological time, some natural theologians (among which Adam Sedgwick) came to formulate a developmental or evolutionary doctrine called 'transformism' or 'progressionism': it considered man as the goal toward which the totality of evolving creation had been striving. This form of evolutionary thought did not see either bodily or geological continuity between animals resembling each other morphologically. Some naturalists, for example Richard Owen and Louis Agassiz, embraced this progressionism of natural theology. Living nature as they saw it stood in stark contrast to the Newtonian vision of a nature as a world machine moving relentlessly according to immutable laws of

[1] cf. L. Eiseley (1961).

nature — although also ordained by the Creator. Darwin's evolution theory by means of 'natural selection' — selection by blind nature through the struggle for existence as opposed to conscious divine or human selection — brought about *a convergence* between the theologically inspired evolutionary view of nature and the mechanical world order inspired by the natural science of the modern period. According to Darwin's view, living nature's origins and present state could be accounted for without any appeal to 'metaphysical presuppositions' or 'occult forces'. Evolution was natural, infinite and fortuitous.

The debate on these matters was heard in every country, including The Netherlands.[2] What strikes us is, first of all, that some early explanations of the origin of species by Dutch naturalists closely resembled Darwin's theory.

In 1848, Fransiscus Cornelis Donders (1818-1889) gave his inaugural address *The harmony of animal life: the manifestation of laws* at Utrecht University, clearly anticipating Darwin's idea of natural selection.[3] Donders began by pointing to order and harmony in nature. Everything is a part of that great natural organism and constitutes a link in the immense and indivisible chain that has neither beginning nor end. Nowhere is this order and harmony more striking than in living nature, especially in the interdependence of the animal and vegetable worlds. However, science is not content with a mere description of the order and harmony. It wanted to discover the basic laws governing their development. So far this had not been accomplished with regard to living nature, which was too complicated and variegated to be subject to laws. And thus the existence of plants and animals was regarded as proof of God's wisdom. What people had attempted to study thus far was God's purpose in creating each species. But science is not concerned with goals. It focuses on empirical knowledge, i.e. on sensory perceptions. It is exclusively concerned with facts. And what does man know about God's goals? Nothing at all, hence they can never be proved. Instead of studying the goals according to which living nature is supposed to have been created, Donders proposed a study of the *laws* according to which living nature had become what she actually is. (He compared his enterprise with the work of Johannes Kepler, who discovered many laws governing the course of the heavenly bodies, but

[2] A more extensive earlier (English) version of this chapter appeared in Th.F. Glick (1974, pp.269-307).

[3] F.C. Donders (1848).

failed to find the one fundamental principle underpinning all the separate laws; to find this a Isaac Newton was needed).

Donders was a supporter of 'transformism' or 'the development hypothesis': the species as we now observe them in nature, had reached that state during gradual development throughout the ages. He distinguished two aspects in the order and harmony of nature. First the relation existing between organism (plant or animal) and environment: the need for food, for instance, adapts to what is available. Secondly the relation between the vital needs of the organism and its own inner organs: the relation, for example, between the length of its intestines as determined by its food intake.

In order to explain the harmony in nature Donders formulated three 'laws'. In the first, he suggested that every animal organism is transformed by the permanent conditions in which it finds itself. The transformation accursed because living beings adapted themselves harmoniously to external influences. With this law Donders recognized, in effect, the variability of the species.

Whereas the first law focused on the transformation of the species, the second concentrated on the transformation of the organs. According to this second law, every organ and every part of the body will be transformed as a result of the constant influence of the 'will' and other circumstances, in such a manner that it responds to the demands of the will and the environment. This law, reminiscent of Jean-Babtiste Lamarck, implies that the habits or the capabilities of creatures — strength, agility, and precision of movement — have grown from their vital needs, and so have their senses and instincts. Moreover, if *one* organ changes, the others also have to adapt themselves. Donders' vision of nature was animal-orientated: he explained the phenomena observed in the vegetable kingdom on the model of the animal kingdom. In general, it can be said that nineteenth-century biologists were more impressed by the energetic and dynamic life of animals, by their will to live and multiply and by their active capabilities than by the calm, quiet life of plants which had served as the natural-history model in the eighteenth century.

Donders' two laws implied a third: that the acquired condition of the ancestors is inherited by posterity. Donders believed that because of this hereditary process, creation as a whole had become more and more perfected. In support of the third law, Donders pointed to the fact that the animal species had indeed changed through the ages under the influence of external changes, and that agricultural experts were making use of this phenomenon to breed artificial stock. (This was Darwin's premiss as well; it was the basis of his theory of natural

selection.) And since man has lived in so many different parts of the world and has developed so many different civilizations, the human race, according to Donders, has changed most in the course of time. Donders did not yet have the perspective derived from the knowledge of immense passages of time. This factor had become relevant to natural history via geology, which came to play an important part in Darwin's theory of evolution.

Donders' vision of a plastic — one would almost say 'malleable' — nature, combined with a mechanistic view of nature functioning on the basis of laws, is quite remarkable. It denies any underlying purpose for the development of nature or any design in nature. But for him the absence of such a purpose was no reason to doubt the goodness — and therefore the existence — of a Creator. The element of the cruel struggle for existence is absent. Peace in nature had not yet been disturbed by the continuous struggle between life and death. Were these the reasons why Donders' ideas did not provoke the uproar caused by *The Origin of Species*? The fact that Donders anticipated Darwin in many respects explains why, several years later, he readily accepted Darwin's theory.

In 1858, one year before *The Origin of Species* was published, Jan van der Hoeven (1802-1868), professor of natural history at Leiden University since 1835, published a short treatise on the successive changes in animals during the various geological era's.[4] His publication dealt with the question whether the varieties of animals and plants could be explained by gradual development in which nature itself created its many forms of life from earlier and lower forms.

The different layers of the earth had shown that the Earth could look back on an immense history, far longer than could be deduced from the Bible and also much longer than the millennia it had taken to give the great empires of the Orient a place in world history. Geology confronted scholars with the bewildering fact that fossil remains of plants and animals were to be found in older strata, remains of species that were now extinct and had disappeared from the world in some mysterious way. Had they been wiped out by some natural disaster or had they simply died out? What sort of animals had they been? Had they disappeared in the flood or in some other calamity? Had these 'ante-diluvian' creatures perhaps come into existence and subsequently disappeared in a slow process of natural causes? An increasing number of new species were discovered during

[4] J. van der Hoeven (1858).

scientific expeditions and during research voyages to overseas countries. Thus the gaps between the species were gradually filled in and the differences between them became increasingly smaller. Sometimes it was even difficult for the scientists to know whether they were dealing with a variation of a known species or with a completely independent species. The question arose as to whether all these animals, some of which occurred only in very limited territories (e.g. islands), had indeed been created separately by God as suggested in Genesis. A more painful question was whether the fate of the extinct species was actually in keeping with God's goodness.

If, Van der Hoeven argued, transformism were true, there could be no missing link in the chain of developing perfection: it would have to be assumed that some day the links as yet unknown would be found, either in living nature or in the fossil remains of forms now extinct. Van der Hoeven was convinced that this assumption taxed the imagination too far. Once we venture into the maze of imagination and abandon the *terra firma* of science, our mind gives birth to images without substance. Van der Hoeven found an example of such phantasy in the paintings produced by Benoit de Maillet at the beginning of the eighteenth-century. Rich in imagination, the latter showed how all life had started in the sea and how birds had developed from flying fish.

Van der Hoeven admitted that the fossil remains of plants and animals found by geologists in the various strata might indeed indicate that the 'development theory' was correct. He was familiar with the works of George Cuvier, Richard Owen, Louis Agassiz and Adolphe Broginart, all of them writers who agreed that certain plant and animal species now extinct, had once existed. In answer to the question as to how these ancient life forms could have died out, Van der Hoeven rejected the catastrophe theory, which suggested that a flood or some such disaster had wiped them off the face of the earth. He also rejected the development hypothesis, since nothing in our experience shows that it is possible for new forms of life to appear in such a way. (Van der Hoeven was clearly unfamiliar with the work of animal and plant breeders and was thus unable to include their experiences in his considerations.) How can we prove that the extinct life forms found by geologists did not exist in era's preceding the period of the relevant stratum? Van der Hoeven was aware that the idea that each species was created separately, did not constitute a true explanation of the origin of species. It was rather a confession of faith. And yet, despite the contemporary advances in geology, he decided for the time being to maintain that belief. If we confess our ignorance, the very basis of science — namely that scientific knowledge has to be founded on

facts — is not violated. He expressed the hope that we might eventually discover the laws according to which the Creator had created living nature.[5]

Van der Hoeven felt that the discovery of extinct animal and plant species confronted him with something utterly incomprehensible: who can hold, he exclaimed, that the gradual development of an animal *with* eyes out of an animal *without* eyes is a lesser mystery than God directly creating of an animal complete with eyes? Van der Hoeven believed that it was not so much a matter of science closing its books at this point and faithfully accepting the incomprehensible, but rather of science not even having opened those books at all.

Darwin reacted quite differently to the mystery of the origin and development of species. He would not resign himself to the idea that science could find no explanation for such an important question as the origin of species, not even for the time being. He was driven by a *fierce desire*[6] for knowledge and understanding. In the historical sketch appended to *The Origin of Species* some time later, Darwin made an ironical remark about the modesty with which zoologists used the word 'creation' — as a label for a process that they did not understand.[7] Darwin regarded such an attitude as beneath the dignity and vocation of science. In his historical sketch he was particularly scathing about Owen, who had expressed his thoughts regarding creation in a similar way to Van der Hoeven when he wanted to express his ignorance as to why a particular bird had come to live in one particular area, and nowhere else. But the limited territories inhabited by some creatures undermined the concept of separate acts of creation — even for Owen himself. As Darwin quotes Owen:

> These phenomena shake our confidence in the conclusion that the Apteryx of New Zealand and the Red Grouse of England were distinct creations in and for those islands respectively. Always, also, it may be well to bear in mind that by the word 'creation' the zoologist means 'a process he knows not what'.(21)

One may wonder about Darwin's vehement reaction to such a stance. Did he equate ignorance with laziness? Or perhaps with a lack of trust in human ideas? Or with a lack of courage to oppose established ideas — with cowardice? Whatever Darwin's thoughts about the matter, he

[5] For the complex relationship between science and religion at the time see F.M. Turner (1974), H.W. Paul (1974) and J.G. Hegeman (1970).

[6] Ch. Darwin (1958c, p.101).

[7] Darwin added this to the third edition (1861) of *The Origin of Species*.

himself was consumed by the desire to force nature to "reveal the mystery".[8] Darwin disciplined his desire into years of patient study — a study — it would seem — as continuous, patient and meticulous as he considered nature to work at her auto-creation.

After reading *The Origin of Species*, Van der Hoeven could not deny that Darwin was an excellent researcher. At the same time he saw that Darwin was not the 'materialist' many took him for. For Darwin maintained that there had been a first Creation. And yet Darwin did not convince him. Van der Hoeven considered that Darwin's proofs for natural selection were insufficiently corroborated by facts. In determining his position towards Darwin, he opted neither for the possibility of separate acts of creation for each species, nor for a 'godless' natural evolution in which the struggle for survival played such an important part. He had observed that the image of a cruel nature made many people doubt the existence of God. Not only unbelievers, but believers too were beginning to wonder how such cruelty could accord with God's goodness — this seemed inconceivable. He wondered — rightly, we may say — why everyone was paying so much attention to the problem of the origin of *living* (organic) nature but not to that of anorganic nature — the minerals, for instance: anyone studying *that* problem would not be quick to argue for or against the existence of God. In his eyes many availed themselves of the opportunity to turn all the attention to the struggle for existence in living nature, since this struggle provided them with a weapon in their arguments against the existence of God. Eventually this turned Van der Hoeven against Darwin's theory of evolution.

Van der Hoeven expressed surprise that some people qualified creation as a *hypothesis* — as if the concept of creation could be ranked with fantasies *à la* Benoit de Maillet. He therefore maintained the cautious view that he had adopted some years before: that science had not yet reached a real understanding of the problem. He considered that this attitude could more easily be accorded with belief than Darwin's.

A third Dutch naturalist named Pieter Harting (1812-1885) had become involved in the debate over the origin of species before 1859. He was appointed professor at the university of Utrecht University in 1841 and soon became friends with Donders.[9] In 1857 he published *A*

[8] Ch. Darwin (1958c, p.101).
[9] P. Harting (1861).

comparison between the prehistoric and contemporary creation, consisting of two papers, read in 1855 and 1856 respectively.

In his preface Harting pointed out that God had endowed man with reason and thereby imposed on the believer the obligation to study nature. Such study, Harting believed, should go deeper than a mere observation of facts. It is not sufficient to declare that the world is a beautiful work of God, said Harting, brushing aside Van der Hoeven's scruples about a more speculative approach to science. He held a different view of science, especially with regard to bridging the gaps in knowledge with reason (here reason begins to look remarkably like imagination). Harting lent his full support to the emerging logic of discovery, which maintains that the researcher sets up hypotheses and attempts to verify them by empirical research. Once a hypothesis is verified, he sets up new ones. And so on.[10]

We see changes taking place in the world, Harting continued, and changes require the passage of time. We also notice that changes are the effects of prior causes. We see a series of causes and effects, links in a chain, the end of which is in the hands of the Almighty. Unfortunately, we cannot study all the links in the chain of creation, due to the weakness of our senses and the brevity of our lives. However, such handicaps should not be used as an excuse to neglect the study of infinite space and time. In his study of nature, Van der Hoeven had refused to fill the gaps in knowledge with outcomes of his imagination. Darwin did not shrink from doing so, but kept in mind the dangers inherent in such an approach. Harting on the other hand, considered the filling of gaps in knowledge a task for the imaginative reason. Therefore the problem of the missing links was less problematical to him than to Van der Hoeven.

Harting wanted to demonstrate in his papers how science, particularly geology, affected our understanding of historical time. The world, he explained, apparently has a past going back millions of years. During this enormous stretch of time all kinds of species appeared to have existed that have now become extinct. After the lectures one of his listeners expressed surprise that Harting had made no mention of the story in Genesis. He replied that the biblical account bore as little relation to science as the cosmogonies of the ancient Greeks and the Indians. Yet Harting had still not officially announced his support for the development hypothesis at the time because his senior colleagues had advised him not to go too far. He took their advice, although he

[10] cf. chapter four, p.101.

was already convinced in his own mind of the correctness of the hypothesis.

This discussion shows that the development hypothesis had already begun to cause unrest among religious people before the publication of *The Origin of Species*. Darwin knew this. He was intensely relieved when his publisher made no objections on this point when he submitted his manuscript. He had discussed with his friend Hooker how he would defend himself if that would have been the case. But his worries proved unfounded: the book was published as it was.

In 1859 Harting was visited in Utrecht by the famous geologist Lyell. Together they had extensive discussions about the evolutionary hypothesis. Lyell told of his friend Darwin, working on a book that would cause an uproar. He added that he himself was still hesitant about accepting Darwin's theories. (At this point he had not read the actual book and had only had discussions with Darwin about his theories.) However, he regarded it as a hypothesis which would have to be taken seriously in the future.

Three days before *The Origin of Species* was published, C.A.J.A. Oudemans gave his inaugural address at the University of Amsterdam *Concerning botany seen in its gradual evolution from the earliest times up to the present.* In his evaluation of the various reasons advanced for the extinction of certain life forms, he appeared to opt for the idea that species slowly die out from natural causes, not because of catastrophes like a possible flood — as recorded in the Bible. When asked how he knew that extinct forms had not existed from the very beginning, Oudemans replied that the earth itself provides the answer to the question: it shows how the different life forms have succeeded each another in the course of time.

Harting's efforts to keep the debate on the origin of species peaceful after publication of *The Origin of Species* proved to be in vain. He wanted Darwin's theory to remain a purely scientific matter and above all, being a middle class liberal, he wanted to prevent its being compromised by radicalism.

In the 1850s Harting had started to write a textbook on zoology for his students. The first volume was published in 1862, and showed great caution in his exposition of the evolutionary hypothesis. He suggested that the hypothesis in itself was not part of science as such: science was not yet sufficiently advanced to pronounce a well-founded opinion on such matters. He considered such ideas to be largely subjective (speculative) and he did not wish to attach greater importance to the subjective idea of evolution than to any other subjective ideas, like e.g. creation. But as everyone is entitled to his

own opinion, he felt free to express his feelings on the subject, not for personal advantage, but in order to provide a platform for others who were interested in the same subject, to demonstrate both the weaknesses and the strengths of a hypothesis, in this case the evolutionary hypothesis. Moreover, formulating an opinion or a hypothesis implies a recommendation that research should be pursued along certain lines, a procedure which would stimulate his students. As far as he was concerned, he wrote in 1862, the era of Linnaeus with its ideas about strictly delineated and unchangeable species was coming to an end. New insights were emerging, but in science, as in politics, conservatives and radicals oppose each other. With his book Harting hoped to provide a bridge between the two camps, by indicating exactly where facts ended and hypothesis began. In this way he gave credit to the hypothesis where he considered it was due and showed that cautious acceptance could lead to greater insight into the truth.

Two years later, in the second volume (1864), Harting dropped the distinction between facts and hypothesis. Now he stated unconditionally that the species were *temporary and transient carriers of a more or less determined life form*. He compared the zoological species with the words of a language: both are subject to change. Harting suggested that the old-fashioned descriptive zoologist did not know how to deal with newly discovered forms of life, which appeared to belong to two species simultaneously. The more modern and *philosophically* orientated zoologist, however, realized that these newly discovered hybrid forms point to genetic inter-species relations. He stated in no uncertain terms that the genetic system of zoology was the right one. Harting expected that it would not take long for everyone to agree with the theory of evolution, even if opinions did continue to vary as to how the transformation of species actually occurred.

Because of his moderation and restraint in defending Darwin's theory, Harting contributed more than anyone else in The Netherlands to the diffusion of Darwin's ideas in university circles. In the 1860s the older generation, like Van der Hoeven, bowed out. The new generation of natural history professors (or biology, as it was now being called) were Darwinists.

In the second volume of his textbook Harting did not discuss Darwin's theory of natural selection and the mutation of species by the struggle for survival. Even in his last scientific statements on the subject — an introduction given on the occasion of the publication of Herman Hartogh Heys van Zouteveen's translation of Darwin's *The Descent of Man* (1871), — Harting again avoided Darwinist expressions such as *natural selection* and *struggle for survival*. He was to start using

the terms under the influence of a factor completely outside the realm of science: the Franco-Prussian war.

The horrors of the Franco-Prussian war of 1870 were a savage blow to Harting's optimistic belief in progress. The term *struggle for survival* suddenly acquired shocking meaning for him. People strive after happiness, he wrote in 1870 in a speech entitled *The struggle for life, vide* man's dreams of a golden age. But can these dreams ever turn into reality? The answer will depend on the way we reason. Does the belief in a golden age depend on wishful thinking (imagination?!) or on reason? As a man of science Harting was obliged to listen exclusively to reason. But the results were not very encouraging. Life has always been a struggle, he stated, and what we know of life teaches us that as long as there is life there will also be struggle, for, unfortunately, nature is not a good mother cherishing her children. Above and beneath the earth, in the sky, in the rivers, in the sea, war is omnipresent. The earth is one huge battlefield. The weak are prey to the stronger and these are, in their turn, prey to the strongest. Everywhere we find power triumphing over justice. Of the quintillions of animals born daily, all but a few die quickly, and that this has been so from the earliest times, can be deduced from fossils. Life is a circle, in which the death of one organism means life for another. We can observe this in the animal kingdom: a continuous fight for life and death. This spectacle had caused Darwin to recoil, but up till then Harting had, strangely enough, failed to take it into account.

In the human kingdom, Harting continued, things are not much better. Worse, no animal is as cruel as man. Human history is the history of a continually recurring struggle for life, and it teaches us that whole populations disappear from the surface of the earth to make room for stronger people. This happened, for instance, when Europeans settled in regions where climate and soil conditions enabled their descendants to develop freely. The original population was then driven back, until finally it disappeared completely. (Harting most probably referred to the fate of the North American Indians.) We can feel pain at the fate of so many innocent and unfortunate individuals, he went on, and if the opportunity arises we can doubtless try to alleviate their suffering, but the laws of nature know no mercy. It is simply a law of nature that the weak give way to the power of the strong.

Harting looked at the Franco-Prussian war in the light of the struggle for existence: the 'lower' Celtic race was defeated, to be succeeded by the 'higher' Germanic race. However objectionable we may now find such an idea, it was not unusual at the time. Almost

all scientists in Europe in those days were of the opinion that the European Caucasian race was superior to other types of humanity (in this regard Lyell was a remarkable exception).

No matter how cruel the struggle for existence may be, the final outcome will be positive, said Harting in his closing passage. The sense of tragedy dawning upon him seemed to give way to cynicism: a 'the end justifies the means' cynicism.[11]

Harting's acceptance of evolutionary ideas is typical of many scientists (Lyell, Hooker, and Huxley, for instance). After reading *The Origin of Species* they were immediately and completely convinced of the correctness of Darwin's solution to the puzzle of the origin of species. There were natural history experts who, like Van der Hoeven, continued to have their objections. But in general the book was received enthusiastically. People began to look at plants and animals in a different light and research was directed along the lines set out by Darwin.

In *The Structure of Scientific Revolutions* (1962), Kuhn coined the term *paradigm switch* for this type of change. Despite the widespread criticism of Kuhn's view on scientific revolutions, and on the history of science in general as an interaction between 'normal' and 'revolutionary' science, this type of U-turn in scientific thinking remains a remarkable phenomenon. Was Darwin's theory, almost contrary to his own forebodings, watertight after all? Or, were other — hidden — factors involved besides the rational and logical arguments, which won Darwin's readers for his hypothesis and made them overturn their previous beliefs?

3.2 Sociological aspects of *The Origin of Species'* reception in The Netherlands

Since the 1960s we have become aware of the links between science and society.[12] Science apparently does not develop in a vacuum: extra-

[11] Another Dutch social Darwinist was H.J. Betz, see below. J.W. Burrow (1970) analyzes the influence of Darwin on social thought, but does not pay attention to social Darwinism because, as he puts it, it was not 'serious science'. But its influence was all too real.

[12] The literature on this topic has grown exponentially since at many universities 'Science and Society' has developed into a separate field of study. In the context of this study I mention: J. Habermas (1968), D. Bloor (1976), K.D. Knorr-Cetina (1991), L.W. Nauta (1979), H. Radder (1984). I have much profited from discussions in the journals *Science in Context* and *Kennis en methode*.

scientific interests of, for instance, a political, socio-economic or economic nature, plus individual and socio-psychological factors influence its development. Thus a distinction came to be made between 'internalists', who emphasize developments operating more or less autonomously within a particular field of science, and 'externalists' who stress the external influences on science. An 'internal' history of science presupposes an 'external' world. However, external and internal factors are so intertwined that the distinction is becoming vague and meaningless. Science and the culture in which it operates form one whole. Isolating certain conglomerates from the whole is merely artificial, though it can be a useful exercise in opening up and analyzing a particular area of culture or of science.

An apposite example of the complicated relation between science and society can be found in the reception of and interpretation given to Darwin's ideas, for example, in The Netherlands. Darwin's views corresponded remarkably well with the aspirations of the important social groups of the day: first the liberal bourgeoisie, pulling the strings in society in general as well as in the university world, and secondly the freethinkers and socialists who had begun to stress their distinctive features.

Everywhere in Europe the theory of evolution was well received by liberals and radicals, since it undermined the idea of a static political order and offered a future full of hope. An evident example is Karl Marx, who justified revolution on grounds that were far from traditional: not on the basis of (static) natural law that can be violated by a bad political system, but on the basis of the (dynamic) movement of laws of nature.[13] Marx' interest by Darwin illustrates one of the most important consequences of the latter's thinking: the impetus it gave to materialistic atheism — the last thing Darwin had in mind.[14] It is also significant for the broad intellectual movement which was now circulating under the name of 'Darwinism': alongside Darwin were people who were only indirectly connected with developments in biology, even though they may have described themselves as Darwinists: Huxley, Ernst Haeckel, Herbert Spencer, Carl Vogt and Ludwig Buchner, for instance. Darwin himself was almost submerged in 'Darwinism', a phenomenon also happening in The Netherlands at the time.

[13] Because of the important part played by the laws of nature in Darwin's theory of evolution, Marx had wanted to dedicate *Das Kapital* to Darwin. But Darwin did not like the idea, he did not even read the book (the pages of his copy are still uncut!).

[14] D.L. Hull (1974, p.391).

In the 1850s and 1860s Modernism had acquired a great many disciples among Dutch liberals. Modernism was a school of thought within Protestant and Catholic circles which sought a rapprochement between belief and modern culture, especially science. The principal Dutch representative was Cornelis Willem Opzoomer, since 1864 professor of philosophy at Utrecht University. Opzoomer was a deist. He maintained his belief in God, but in philosophy and science, he only accepted empirically verified knowledge as true (scientific) knowledge. Since everything in creation obeys the Great Law of Causality, Opzoomer believed that the aim of science and philosophy was to discover the laws of nature, of history and of society. Christian supranaturalism, especially the belief in miracles gave an erroneous explanation of events in the world of nature and of man.

Opzoomer was a strong believer in world progress, as guaranteed by the development of laws. He was optimistic about the world and history, and was convinced that good would triumph everywhere. After reading *The Origin of Species* Opzoomer accepted the law of evolution not only as the fundamental law of living nature but also as that of history and of the universe as a whole.

Darwin's solution to the problem of the species confirmed the optimism and belief in progress of modernistic liberals like Opzoomer much more strongly than previous evolutionary theories: in a purely scientific manner Darwin had demonstrated the mechanism by which not only history but also nature obeys the law of perpetual progress. And thus *The Origin of Species* was gratefully and in all good faith used by liberals to underpin and justify their social, political and economic ideals – in brief, their ideology.

One of the links between the university community and the general public was the geologist T.C. Winkler, an expert in fossils, and curator of the geological and palaeotological collection in the Teylers Museum in Haarlem. Barely a few weeks after the publication of *The Origin of Species* he had already translated the book, followed in 1864 and 1867 by two articles in which he explained the theory of evolution in his own words. It is revealing to see how he interpreted Darwin. According to Winkler God, in creating the world, made use of the law of evolution. God's greatness reveals itself not in unprecedented miracles but in the fact that the laws function in a regular manner, laws which He had formulated and which rule all creation. Various factors influenced the gradual formation of the species: external conditions, the use of the body and natural selection. Winkler saw the latter as an extremely effective, but (and here echoed Darwin's own words) not exclusive means of bringing about the transmutation of the species. He

attempted to set the mind of the reader at rest who was concerned about the implications of Darwin's theory of the evolution of man (descended from the apes?).

Darwin had only vaguely referred to the subject in *The Origin of Species*: no more than *much light will be thrown on the origin of man and his history.*(449) He had racked his brains finding the wording for this phrase. In 1837 the question of the position of man, if his hypothesis about nature were correct, had occurred to Darwin straightaway. Had mankind, too, developed gradually according to the evolutionary theory? A shocking idea in those days. Like any good strategist Darwin had no desire to compromise his book from the outset by suggesting such a possibility. At the time it was no more than a possibility, even though he was thinking quite strongly along those lines. On the other hand, he had no desire to close his eyes to the issue: he felt that would be dishonest. The phrase quoted above reflects the compromise between these two conflicting thoughts.

But Winkler was not so reticent in this regard: he had no wish to deny that mankind, too, had been formed through natural evolution. The idea posed no threat for him. The fact that mankind is descended from a lower form of life, indeed, that all life originates from one primitive beginning, in no way implies that mankind is a mere animal. Mankind possesses far more complex mental capacities and could not have inherited these from animals. Mankind had received higher powers from the Legislator who had decided at the moment of creation to make use of the evolutionary method. Winkler's acceptance of the theory of evolution did not mean that he believed life had developed at random. There is a clear plan underlying the evolutionary process. Man may be descended from the apes, but he is nonetheless a totally different sort of creature. If people only realized that their descent from the apes lay millions of years ago they would not be so shocked about having apes in the family.

Winkler foresaw a great future for man: he will develop into an even higher being, especially as regards his mental capacities. The evolution of mankind will be furthered by the phenomenon that when highly developed human races meet lower races, the latter will become extinct. (It is possible that Winkler is referring to passages in *The Origin of Species* in which the animal and human kingdoms appear to overlap.) Evolution of life, of the instincts, and of reason in the successive geological era's also shows, according to Winkler, how the ascendancy of mind over matter is steadily being established in the world. In general Darwin's disciples put far more emphasis on the

aspect of progress than Darwin himself — it was an aspect that he even began to doubt in later years.[15]

The Utrecht scientists Donders and Harting were typical modernistic liberals, and close friends of Opzoomer's. Both shied away from the social radicalism of the materialistic philosophers (for example Jacob Moleschott), both approached the education of the people in a paternalistic manner.

Donders, for instance, pleaded with the government to start teaching the people to change to a healthier diet — an education that was to be supervised by the medical and physiological sciences. He regarded the Royal Netherlands Academy of Arts and Sciences as an institution that could guide the government in achieving progress.[16]

Harting too was aware of his social responsibility as a scientist for the education of the people. In 1851 he founded a non-specialist journal: *Album of Nature: a Work intended to disseminate Knowledge of Nature among civilized Readers of all Ranks of Society.* Controversial subjects such as evolution were barred from its pages: he regarded his reading public as too immature for that sort of thing.

Harting demonstrated the same facility as Opzoomer, Winkler and Donders, when it came to combining religion and science. The plan of creation is revealed in creation itself. Creation offers itself to us as a unified and continuous whole, and the plan emerging from it is that of a continuously advancing perfection. Man, still in the process of developing, is the last link in this endless chain of creatures. Nature's motto is *excelsior*, ever higher, and in multiplying the wealth of knowledge the scientific researcher is cooperating with the Creator in attaining his goal with the world. It was clear to both Harting and Opzoomer that the progress of science could in no way conflict with the Christian faith nor adversely affect morality. Anyone shocked by the notion that science was suggesting the supremacy of laws as a replacement for God's guidance should realize that these laws represented *God's thoughts*. Of course, there were conflicts between science and the Christian faith, for instance, when certain scientists used their materialistic philosophy to attack faith. But this anti-religious attitude was only found among (second-rate) scientists who failed to see beyond the facts (like Van der Hoeven) or beyond matter

[15] Ibid., p.390.

[16] He expected little of the common people themselves, uneducated as they were. He rejected Moleschott's habit of directly appealing to the people. Do not preach materialism to the people, for that will only cause confusion. To exercise authority, according to Donders, it was better that the people be believers than atheists.

(like Jacob Moleschott). A real scientist (like Harting himself!) used his mind to penetrate into the world of the immaterial, the kingdom of the spirit — in other words, the empire of what is eternal, true and unchanging.

He admitted that most defenders of materialism are scientists, but he excused their atheism as a deplorable overreaction to the narrow-minded theological conceptions of the church. In their anger they throw out the baby (faith) with the bath-water (the orthodox explanation of faith). Harting regretted this type of over-reaction: it is putting science in jeopardy. Of course science must enlighten society: after all, progress is supposed to result from the development of science. Alas, according to Harting, the radical scientists fail to realize that most people are children *qua* reason. True *apostles of science*, however, respect the common man and avoid tossing around ideas like the theory of evolution, for which ordinary people are not yet ready.

The parallel with the liberal interpretation of the world (rule of mind over matter in the universe, and rule of liberals over the common people) will nowadays be obvious to most readers. But at the time it was noticed by only a few — the leading role of the liberals being accepted by the overwhelming majority of the people.

The freethinkers, on the other hand, were not slow to recognize the relationship between liberal science and modernist philosophy. While the liberals were busy interpreting and exploiting Darwin as an ally in their Modernism and in their struggle for modernization, the freethinkers hailed Darwin as the standardbearer of materialism and atheism. They embraced him as the representative of genuine science, a science which placed an effective weapon in their hands for the struggle against the liberals and their spineless compromise between God and science. From 1870 the freethinkers made their support for the growing labour movement more and more clear. Many workers subscribed to their journal *The Dawn*. In this ambience the main significance of Darwin's work was that a mechanistic explanation of nature had been discovered which rendered God superfluous. Examples of men subscribing to this interpretation of Darwin are Hartogh Heys, Johannes van Vloten, H.J. Betz and Multatuli (Eduard Douwes Dekker).

Hartogh Heys went to study law in Leiden according to his father's wishes but immediately after getting his degree he threw his law books into one of the Leiden canals. He was far more interested in the study of science, particularly chemistry, geology and zoology. One of the theses of his dissertation (in 1866, on a chemical subject) was that the Linnaean notion concerning the immutability of the species could not

be sustained. He was appointed lecturer at Leiden University and in that capacity he did not hide his supportive feelings for freethinkers and Darwin. This brought him into conflict with the faculty of theology and with the Dutch Reformed Church. In 1867 a chair of zoology was established, and Hartogh Heys' name headed the list of candidates, but he was passed over owing to the efforts of orthodox opponents. Was it Darwinism that thwarted Hartogh Heys career or was it his impetuous and tactless radical behaviour? Curiously enough Emile Selenka, who was appointed to the chair in 1868 was a Darwinian. Whatever the facts may be, Hartogh Heys withdrew from university life.[17]

After what had happened in Leiden, Hartogh Heys became a strong opponent of faith and church — thus illustrating Harting's proposition that the narrow-mindedness of the orthodox played into the hands of the atheists. Hartogh Heys regularly published articles in *The Dawn* even though he remained politically conservative. His published works include a wide range of books on chemistry, economy and anthropology. He carried on an extensive correspondence with important intellectuals like: Voght, Moleschott, George and John Romanes, Darwin and his son Francis. He was, and still is, best known for his translation of Darwin's works: all of them together constituting Darwin's *Masterpieces of Biology*. He had started with *The Descent of Man*. Darwin sent him the quatrefoil of the book one by one as they appeared from the printer and Hartogh Heys returned them to Darwin with his comment, much of which Darwin included in a subsequent edition.[18]

In his foreword to the translation of *The Descent of Man* Hartogh Heys wrote that Darwin had by now collected so much factual evidence to support his hypothesis, that man's origin as seen by Darwin could actually be accepted as a certainty. Hartogh Heys attempted to temper the negative emotions aroused at the idea of man's descent from the apes, by painting a picture of a beautiful future: the human brain had developed tremendously since the Middle Ages and, provided humanity continued to exercise, it the human brain would improve and become even stronger. This type of trained brain would come to the aid of

[17] He travelled a great deal, was present at the opening of the Suez canal in 1872 and founded a colony of Dutch farmers in California. Gout caused him to return to The Netherlands, where he retired to the province of Drenthe to pursue his studies in private.

[18] The series has appeared since 1890 (Arnhem and Nijmegen, Gebr. E. and M. Cohen).

man's descendants when the time would come to fight for survival. But strangely enough, not a word about the horrors of this struggle for survival nor about justice and injustice.

The radical Hartogh Heys and the liberal Harting did not get on very well. After Harting's rejection of an article submitted by Hartogh Heys to *Album of Nature*, the latter founded his own journal (1871): *Isis: Journal of the Natural Sciences*, in which he published information about Darwin's new publications as well as about important works on Darwin appearing abroad.

Johannes van Vloten, another freethinker and Darwinian, was a historian and a materialistic philosopher à la Haeckel. From the political and intellectual point of view he was decidedly left-wing. After completing his theological studies he was the first person in The Netherlands to defend David Strauss' book *The life of Jesus* in 1842. In 1849 he left the church. Like Hartogh Heys, he was passed over for a professorship and continued his studies in private. He founded two journals: *The Messager of Life* and *The Humanist*, in which he defended Darwin with great enthusiasm, especially when discussing foreign publications.

Van Vloten rejected belief in God as unscientific. God was no more than a projection of psychological needs. He had nothing but contempt for the modernists and their attempts to remain true to faith *in this age of Darwin*. A truly modern attitude implied rejection of all forms of the supernatural, and to combat, for instance, diseases with fresh air, light, a healthy diet and better housing rather than by praying and fasting. He considered it Darwin's greatest accomplishment to have shown that nature's efficiency had developed without God's intervention. Nature developing in this mechanical way is blind and therefore not responsible for good and evil, which is solely man's responsibility. Man has the capacity to understand increasingly the relationship between all things, thus to control nature and, out of love, to mitigate the suffering to which all creatures are subjected.

One of the contributors to Van Vloten's *The messager of life* was H.J. Betz, like Van Vloten, a materialist *à la* Haeckel, but lacking Van Vloten's social consciousness. Betz was a social-Darwinian, believing that society was the result of the blind forces of nature. Darwin had clearly demonstrated that there was no plan behind nature. Betz believed that the struggle for existence raged in society as in nature. In the social arena the rich will win: their children are healthier, and people with healthy bodies have healthy ideas. Poverty and stupidity are mutually reinforcing. Since the worlds of nature and culture are

ruled by blind natural forces, Betz did not feel called upon to combat suffering and evil.

The most famous and gifted freethinker was Multatuli, sarcastic opponent of the sanctimonious liberal bourgeoisie and staunch champion of 'the people'. In 1861 he published his famous article in *The Dawn* entitled *Prayer of an unbeliever*, many times reprinted since then. In it he confesses his despair about a God who fails to reveal himself in creation and who abandons his children in their struggle for humanity and justice. The final words are: *O God ... there is no God.*[19] According to Multatuli, nature shows no trace of a loving God. Nature is stupid, everything is put together at random like goods in a department store. He despised the modernists who skilfully combined capitalism and faith, coal and Bible.

Multatuli never actually read any of Darwin's writings, but he was certainly an important factor in the disseminating of his ideas. In his novel *the History of Woutertje Pieterse*, the story of a boy belonging to the petit bourgeoisie, the hilarious story of Miss Laps, a lower-middle-class lady, is a good example. She nearly faints when Woutertje, innocently airing his newly acquired knowledge, tells her: *Miss Laps, you are a mammal.* Other people, she protested, may be mammals, but she is a decent lady, for isn't her father a decent grain dealer? Multatuli considered Darwin not Darwinian enough: after all, he still believed in a creator. He qualified Darwin as *childish* and his books as *patchwork.* He had his doubts about natural selection. Take, for instance, the evolution of the tailcoat: from loin cloth to festive garment. The two buttons at the back, he explained, have the same significance as the nipples of male mammals or the *rudera* of the jaws in animals with lungs. It is clear that everything points to a slow development, and thus the idea of creation is completely superfluous. However, it should be noted, he concluded, how little that insight and Darwin's natural selection can actually solve: buttons do not mate!

Multatuli's writings indicate the influence of Darwinism outside the academic world. He was one of the first to use the anglicism *evolutie* instead of the current Dutch word *ontwikkeling* (development). He spoke of the *free Darwinian development* of a language and of the 'struggle for survival' of the constituent elements of a problem. (The psychiatrist Gerbrand Jelgersma too, while still a supporter of the association psychology, spoke of the *struggle for survival of impulses in*

[19] Multatuli (1950, vol.10, pp.59-61).

the nerve pathways where the victorious ideas became *conscious* while the weaker ones remained *unconscious.*[20])

A last example of the dissemination of the Darwinian intellectual legacy among the radical left is provided by Carel Vosmaer. This freethinker, classical scholar, materialist and friend of Multatuli, Van Vloten and Betz, wrote in one of his columns:

> Behold, for your Enlightenment I bestow on you the Third Testament containing the acts of Baur, the Gospel according to Strauss and the Book of Darwin.[21]

As a result of the annexation of Darwinism by the liberals and radicals, the way to Darwin was closed to many Christians almost from the very start.[22] This is quite remarkable since *The Origin of Species* contains enough impulses for a less fearful attitude. Darwin's appeal to a Prime Cause was more than a mere opportunistic trick and more than a stopgap solution. The American natural historian Asa Gray even wrote to Darwin that he saw in his work an argument for *design in nature.* Though this irritated Darwin tremendously, we still have to admit that on this point — as on many others — Darwin remained ambivalent.[23]

Due to its links with anticlericalism, Darwinism in all its diversity became the semi-official doctrine of the universities in The Netherlands and abroad.[24] To some extent this is still the case: anti-religious exploitation of the theory of evolution has led to the finality in nature being regarded as anathema in scientistic-oriented university circles.[25] Small wonder that Christians had little time for Darwin. The alliance struck up between liberals, freethinkers and Darwinism compromised the theory of evolution so severely, in their view, that they rejected it without racking their brains about it.

The reaction to the theory of evolution from Dutch catholic circles was characterized by Ludovicus Jacobus Rogier as "an instinctive rejection by people unaware of the facts".[26] The Roman Catholic priest

[20] Ilse N. Bulhof (1983, pp.127-130).

[21] Quoted by O. Noordenbosch (1931, p.72).

[22] See note 4 of this chapter.

[23] H.W. Paul (1974, p.418).

[24] Ibid., p.421.

[25] This seems quite clear in Jacques Monod. For discussion of the entire question, see E. Gilson (1971). See also H.W. Paul (1974, p.423).

[26] J.G. Hegeman (1970). See also for Dutch catholic reception of evolutionism: P. Smit (1980).

B.H. Klönne did not even accept the new geology and spoke disparagingly of palaeontology as largely a figment of the imagination. In a publication dated 1869 Klönne bluntly suggested that if man's descent from apes was a necessary consequence of Darwin's theories, then his notions were already condemned. The philosopher Franciscus Becker, teacher at the seminary in Culemborg, wrote an article in 1873 concerning the limits of experience, in which he rejected the descent of man from the apes as unproven by science. To remain on the safe side he did not discuss the specifically biological aspects of Darwin's work.

O.P.J.F. Vermeulen, biologist and conservative Member of Parliament, rejected Darwin on biological grounds, but condemned him most of all for the immoral consequences of his theory. The Dutch catholics were apparently unacquainted with *Genesis of Species* by St. George Mivart (1870) in which the catholic reconciliation with the evolutionary hypothesis was announced, although the book did forego discussing the idea of natural selection.

In the context of Dutch society the attitude of the protestants was more important at the time than that of the catholics, since the latter had only recently embarked upon their social and intellectual emancipation. The modernists, who considered themselves the true inheritors of the protestant legacy[27] reacted, as we have seen, to Darwin in a positive manner.

Initially Darwin's reception in orthodox protestant circles was just as negative as with the catholics — albeit with greater diversification.[28] There were protestants who took the Bible, especially the Book of Genesis, literally. But Lambert Tinholt, minister at Koudum in the province of Friesland, suggested a compromise: exegesis should attempt to find out where the Bible conflicts with the natural sciences. Then the faithful should be instructed as to how to interpret the Bible on these points, in order to avoid contradictions with proven scientific facts. As an example he took the new insights into geology: one day in Genesis can be explained as one geological era. This concordist point of view, not defended by catholics, was also adopted by Jan Lodewijk ten Kate. In later years Ten Kate was a minister in Amsterdam and a much-read poet in his time. He wrote a long and

[27] The modernists rejected the doctrines of Calvin and the decisions of the 1618 Synod of Dordrecht, they still considered themselves to have retained the core of Calvinist religious belief.

[28] J.G. Hegeman (1970).

tedious poem entitled *The Creation* in which he attempted to integrate modern geology into the biblical story of creation (1867).

However, none of the representatives of orthodox protestantism gave up the idea of separate acts of creation for each species. Consequently there was no room in their view for Darwin's ideas about natural selection and natural development of the species — until Abraham Kuyper discovered a way in which progress and Darwinism could be integrated — though with some restrictions.

In *Evolution*, his inaugural lecture as vice-chancellor of the (protestant) Free University of Amsterdam in 1899, Kuyper referred to the fact that science had concerned itself exclusively with empirical, observable facts before the theory of evolution. An explanation of the invisible and mysterious aspects of life was left to faith. But since then the evolutionary idea had conquered every field of human knowledge, thus leaving nothing to faith. The efforts of Spencer and Haeckel had provided the *Anti-Christian* with their own all-embracing religious system, religious because the theory of evolution itself was based on a hypothesis, an idea, a belief. But *the ghost of decadence* hovered over this new *belief*, according to Kuyper, because the Darwinian concept of the struggle for survival led to various forms of misuse of power — from power politics *à la* Bismarck to imperialism. This misuse of power landed the world in dire straits comparable to those of the Late Roman Empire: the collapse of our world, too, was imminent. Could this downward spiral be stopped? Kuyper passionately believed the way to do so would be by ceasing to *whore with Evolutionism*. We should look at scientific theories such as evolution from a Christian point of view, i.e. consider them as hypotheses rather than doctrines pretending to provide the truth about reality. Kuyper rejected the idea of evolution as a world view, and he regarded the liberal and socialist world view, so closely connected with evolutionism, as incompatible with the teaching of the Bible. He accepted, however, scientific hypotheses as *Christian* (in agreement with Christian doctrine), but science's claim of having the monopoly of truth, and in particular the idea that Darwin's doctrine of evolution had actually been proved 'true' knowledge, he regarded as *Unchristian*.[29]

[29] Kuyper accepted science – including evolutionism – as a hypothesis for purely strategic motives: if the orthodox Christians – whose champion he was – ever wished to win their place in modern society they would have to gain power. Without power they would never be able to return the country to the faith of their fathers. They would have to be able to hold their own in society, and be *au fait* with modern scientific research, and be able to participate in scientific discussions and experiments, even though it was conducted by infidels.

It is amazing how close Kuyper came to the position of a liberal like Harting:

> The difference between the system of election by God and that of selection by the blind forces of nature is in more than one way merely the difference of one letter.[30]

Summarizing we may say that Darwin's book caused a shock wave that reverberated within the Dutch scientific community and much further afield.

The rest of Europe — with the exception of France where the tradition of Lamarck was still alive, and where no need was felt to transfer allegiance to another theory of evolution[31] — and the United States provided the same diversity of controversial debate. The Darwinian revolution was more widely studied than any other intellectual or scientific revolution, not least because of the powerful, strongly emotional controversies that blew up almost immediately following publication.

An overview of the battlefield shows that *Darwin*, *Darwinism* and *Darwinist* meant very different things to different people: philosophy, materialism, atheism, positivism, the end of teleology in nature. But also the opposite: speculation, a travesty of positivism, a rebirth of teleology, defence of the notion of a Creator and a plan of creation. Darwinism was seen as a weapon for liberals to wield against radicals — and for radicals against liberals, and finally as a plea for a laissez-faire economy, an excuse for the rich to oppress the weak, carte blanche for colonial expansion and a basis for the marxist doctrine!

3.3 The Enigma of *The Origin of Species* success

The evolutionary hypothesis and the idea of the mutability of species had been propagated by various researchers before the publication of Darwin's work and had been conducted in a relaxed atmosphere. This changed because of *The Origin of Species*: Darwin's book totally reversed that atmosphere once and for all. *The Origin of Species* gave rise to passion and pugnacity. Huxley, for example, wrote to Darwin after reading the book: *as for your doctrine, I am prepared to go to the stake, if requisite, in support.* He was *sharpening up claws and beak in*

[30] A. Kuyper (1898, pp.194-195). See also (1902-1904, vol.2, p.24).
[31] Th.F. Glick (ed.) (1974, pp.117-163).

readiness for the combat.[32] Bishop Samuel. Wilberforce launched an infamous attack on *The Origin of Species*, a wild flailing that caused tremendous publicity. Parties began to form immediately: for or against Darwin, pro or con 'the' theory of evolution. No-one actually seemed to realize that there were other theories of evolution besides Darwin's.

Why was the reaction unleashed by Darwin's book so much fiercer than that occasioned by other versions of the theory of evolution? Why was *The Origin of Species* an immediate source of conflict? And how is it possible that one book could be subject to so many different interpretations?

The success enjoyed by *The Origin of Species* was astounding. In England the first edition (1859) of 1,250 copies was sold out the first day, a second edition repeating the same tour de force shortly afterwards. In 1876 in England alone 16,000 copies were sold. The book was also translated into nearly all the European languages and even into Japanese.

Many contemporaries, including Darwin himself, wondered what has caused such a tremendous success. Darwin attributed it to his qualities as a researcher:

> (...) my success as man of science, whatever this may have amounted to, has been determined, as far as I can judge, by complex and diversified mental qualities and conditions.[33]

He mentioned that he had an eye for tiny details that eluded most people; that he was persistent, had patience and was driven by a great love for nature and the study of the natural world; also that he had always worked extremely methodically. And yet his success continued to astonish him:

> I have a fair share of invention, and of common sense or judgment, such as every fairly successful lawyer or doctor must have, but not, I believe, in any higher degree.[34]

However, this may be false modesty. A small incident occurring shortly before publication of *The Origin of Species* is typical for the way in which Darwin himself presented his contribution: as something completely new, thereby suggesting that he was the first to defend the

[32] Ch. Darwin (1958c, pp.225-226).
[33] Ibid., p.58.
[34] Ibid., p.55.

theory of evolution.[35] In the first version of his work he had over-exaggerated and stated that the most eminent scientists rejected the idea of the mutability of species. After reading the proofs, Lyell referred to the passage in question by asking whether Darwin was ignoring G.St. Hilaire and Lamarck or had simply forgotten to add the word 'living'.[36] Darwin wrote back in all haste to say that the omission of 'living' was a frightful blunder and he corrected it in the book![37] The whole of the book shows that this omission was something more than an accidental mistake (a Freudian slip of the mind or slip of the pen). Darwin presents himself in his book as the great hero who fearlessly and all alone slew the monster of ignorance and gave humanity the magic words of 'natural selection', thereby opening man's eyes to how things in the natural world really were. There was no room for predecessors in this self-image. He did not include a historical sketch until the third edition, when his fame was firmly established.[38]

The explanation that the success of his book was partly due to the subject being 'in the air' was rejected out of hand by Darwin. And yet such an explanation was not without grounds. The fact that the evolutionary hypothesis was already a subject of repeated discussions influenced the favourable reception accorded to Darwin's theory, as we have seen in The Netherlands.

A factor most certainly influencing the success enjoyed by *The Origin of Species* was the readiness with which liberals and radicals understood that they could exploit Darwin's theory to lend legitimacy to their own ideological ends and political stances, especially as regards their secularism.[39] This too we have observed in the Dutch example. The same phenomenon occurred in other countries: everywhere the book gave a powerful impetus to anticlericalism, secularism and Modernism, which, of course, only made the book more popular in such circles. But one may be allowed to wonder why the book proved so suitable for such purposes. Politically Darwin was certainly no radical — in fact he had very little to do with politics at all.

[35] Freud used the same strategy in presenting 'his' discovery of the unconsciousness.

[36] Ibid., letters, p.219.

[37] Ibid., note, pp.219-220.

[38] See note 7, p.30. Its title was: "A historical sketch of the progress of opinion on the origin of species previously to the publication of the first edition of this work". He added this sketch, because he had been accused of having overshadowed his predecessors too much.

[39] K. Bayertz (1983B).

Was his view of nature perhaps coloured by his personal rejection of faith and church? Certainly not: at the time of *The Origin of Species* Darwin still believed in a creator, a belief which he never wholly abandoned despite many doubts. So for the explanations given fail to provide a satisfactory answer.

There is another possibility: the book may have been taken out of the closed world of the scientists and introduced into an ambience of non-scientists, where it suddenly took on a totally different meaning. Thus a shocking political pamphlet may have been fashioned out of a work which Darwin — unawares of this potential — regarded as a scientific treatise. This seems a plausible explanation. But it still leaves us with the question of what actually made the book suitable for transfer from a scientific to a political milieu; the more so since we have seen that Darwin's theory of evolution was not as new as the author would have liked his readers to believe.

In this regard it has been pointed out that it was not so much transformism, the mutability of species as such, but rather the way in which these changes were brought about: a natural, mechanical working of natural laws. This explanation is not satisfactory either: there was no absolute contrast drawn between 'God' and 'the law' of nature. In fact long before Darwin's time it had been agreed — and without any opposition from believers and theologians — that natural laws regulate the universe and that such laws were more (or represented something of a higher order) than mere observed regularities as put forward by David Hume; that matter could not organize itself and therefore had to be organized from outside (a rejection of vitalism, of the belief in 'souls' in non-human nature); that living creatures were unbelievably well-adapted to their physical circumstances; that at least in living nature the word 'aim' was not completely devoid of significance; that historical development shows a movement of progress culminating in man. These ideas all point to an evolutionary-oriented way of thinking long before Darwin appeared on the scene. In other words, the universe confronting Darwin had already been very largely 'secularized', in the sense that it was considered to be an independently functioning and independently developing whole. This idea was shared by believers and had very old roots. We can detect its beginnings already in medieval times in philosophers like Thomas Aquinas. In this respect there was no great difference of opinion between Christians and deists,

Darwin included. Darwin further secularized a concept of progress, which already had clear theological roots.[40]

Despite these fundamental agreements Darwin's contemporaries only saw the contradictions between the various groups, and not the common factor: the belief in a universe functioning as an independent whole. Was this concept of the universe so obvious that no-one was aware of its existence as a common framework for reflection, so that it was not even discussed? In that case there remains the question of why — when discussion did eventually break out — it raised so much dust.

On the other hand, we should not exaggerate; the fact that the deists had been working for some time within this frame of reference does not imply that it is unreasonable to see the removal of teleology from nature and from biology as a result of Darwin's work: it was not without reason that the anti-teleological ingredient happened to be the reason *par excellence* why Darwinism fascinated many adepts. Natural selection and adaptation to circumstances ended all interest in the purpose of an organ: it became 'unscientific' to base the definition of an organ on its function; the scientist no longer had the right to regard the wonderful order and harmony of the body of an animal separately from the physiological and chemical conditions which explained it; and these very conditions turned the wonder and the miracle into the ordinary and the comprehensible.[41] But if *The Origin of Species* did indeed give the *coup de grâce* to a moribund concept, surely the shock of it all would not have been so great?

Since the publication of *The Origin of Species*, everyone has identified the notion of evolution with Darwin. Practically overnight it was forgotten that others too had thought about and developed their own models of evolution. Because of this, Darwin's role in the history of biology is at present greatly overestimated: Darwin did not 'create' the idea of evolution: it had been around for a long time. Anthony Leeds explains the over-estimation of Darwin's role as the consequence of the reactions to Darwin's contribution: the force of the reaction was wrongly taken as a measure of his contribution.[42] The result of this optical illusion was that Darwin became a sort of hero of culture. Words like those expressed by Vosmaer aptly illustrate this.

[40] Darwin's views "(...) are ideas made available by natural theology (...). The ecological mechanisms of natural selection are not Christian, but they operate in a universe already accepted and defined by the natural theologians", H.W. Paul (1974, p.405).

[41] Ibid., pp.418-420.

[42] A. Leeds (1974, p.240).

Not only the general public but also many intellectuals to this very day have associated the idea of evolution with Darwin. If this was done by Darwin's contemporaries, how can we be expected to act differently? Scholars undertaking laborious historical research in an attempt to show what really happened and to make adjustments to the standard image of Darwin have rarely achieved much. Hence a present-day author writing about Darwinism automatically assumes that the reader knows what this is all about; that the author himself takes for granted that Darwin's evolutionary model represents the idea of evolution as such, instead of a mere variation; and that anyone from the past dubbed 'Darwinist' was, indeed, a Darwinist.[43]

Actually Freud performed the same feat. Just as evolution is not the exclusive brainchild of Darwin, so Freud was not the sole 'discoverer' of the unconscious: Freud also had eminent but now forgotten predecessors.[44] His publications attracted so much attention that his predecessors were forgotten. Freud has become as much a hero of culture in our time as Darwin in the nineteenth century.

Despite the numerous studies and explanations, there remains an enigmatical side to Darwin's success — indeed, to some extent the mystery only deepens. For if Darwin's ideas were not such a novelty as we are inclined to think, if many other students of the natural world had already toyed with the notion of evolution, if, moreover, the other models could not even be replaced by Darwin's, why did he cause such a shock? Why the violent effect, the scientific revolution, and the general revolution in thinking about and experience of the natural world, which we so closely associate with the name of Darwin?

According to Leeds *something special in Darwin's model - absent from other evolutionary models - must have fired the tremendous reaction it got.*[45] Leeds offers two explanations: first, the almost blinding logic of Darwin's model, which binds all the elements into a single whole, accompanied by the enormous quantity of factual material Darwin succeeded in assimilating into this one structure. In this Leeds follows the explanation offered by Lyell. Indeed, the logic of *The Origin of Species* was the thing that most struck Lyell: if you accepted one argument, you had to accept the whole chain that followed it; each argument follows logically from the one before. It was for this very reason that Lyell showed such hesitation in agreeing with Darwin. He

[43] Ibid., p.440.
[44] Including F. van Eeden. See Ilse N. Bulhof (1983, pp.46-97).
[45] A. Leeds (1974, p.443).

found it difficult to accept the final, as yet unspoken, consequence: the significance of Darwin's model for man. Darwin's reasoning finally convinced him as it were against his own inclination: he could not pick a single hole in the entire argument, so he had to let himself be convinced.

The second reason why, according to Leeds, Darwin found so many defenders was the mechanistic character of the theory put forward, the fact that it provided the image of a purely natural process. Leeds refers to the attraction that this aspect appeared to have in all European countries. Although teleology was not completely missing (*vide* the elements of progress and improvement) in Darwin's model it was nonetheless possible to leave it out: the model worked well without the aspects of wonder and high hopes of gradual progress and improvement. Leeds considers that this was precisely the difference between Darwin's model and the older ones proposed by Lamarck and Cuvier.[46]

Why did nobody, not even Leeds, come up with the idea that *Darwin's success had something to do with his talent as a writer*? Only very recently the rhetorical character of the work has begun to be noticed.[47]

In the avalanche of reviews set off by *The Origin of Species* Darwin's style was seldom if ever discussed. The main focus of attention was its content: its theory and argumentation. But there were exceptions.

Darwin himself mentioned a discussion with an opponent about his cocky style, his self-assured manner and his confidence when arguing away difficulties.[48] Huxley, on the other hand, praised the self-assured manner in which the book had been written:

> Nothing, I think, can be better than the tone of the book, it impresses those who know nothing about the subject.[49]

[46] Indeed, not only did these older models pose no threat to orthodoxy, they even supported it. Lamarck and Cuvier (and we may add Opzoomer, Winkler and Harting) did not remove the spirit from nature in order to replace it with a mechanism: indeed, they actually defended the traditional, idealistic ideas concerning man. Man was in no way reduced to the level of an animal. In addition, these older (liberal) thinkers incorporated into their interpretation of the theory of evolution ideas that were not only of scientific but also of ideological importance (essence, succession, teleology and progress).

[47] See G. Beer (1983, 1984), R.M. Young (1985), J.A. Campbell (1987, 1989).

[48] Ch. Darwin (1958c, p.223).

[49] Ibid., p.225.

The self-assurance that might irritate an opponent was a source of satisfaction to a supporter like Huxley.

There is a surprising comment mentioned by Darwin in a letter to Lyell: someone had told him that he was not in the least interested in what Darwin believed, thought, assumed and was certain of: his only interest was in *proof*. Darwin had replied to this person that in that respect his work might well be seriously defective in that respect, and that he would try to change the *I believe* and *I am convinced* into something more concrete in a subsequent edition. The response to this suggestion was that it would spoil the book: *its charm is that it is Darwin himself.*[50]

Hooker admired the skill with which Darwin handled the enormous quantity of facts and the way in which he bombarded the reader with them. He praised he clarity of the book, though at the same time he found it very difficult to fathom. He qualified it as *the very hardest book to read to full profits, that I ever tried – it is so cream-full of matter and reasoning.*[51]

A striking feature of Darwin's style is his use of metaphors and personifications. It drew criticism Darwin could not ignore, for example from Bishop Wilberforce who rejected *the transference of the argument from the domesticated to the untamed animals* on which the principle of natural selection was founded. In later editions of *The Origin of Species* Darwin attempted to invalidate attacks against his use of personifications and metaphors and his argumentation. I will return to this important point in the next chapter.

By and large, however, the specifically *literary* elements of the book evinced practically no comment, neither positive nor negative. At first sight this is understandable: Darwin's concern, like that of the reader, was with the content, the theory. The way in which this theory was presented, its form, seemed a side issue; any literary qualities fell outside the interests of the reader, scientific or otherwise (religious, for instance). The readers just did not notice.

But was this a sensible attitude? Would it not have been better if the readers had rapped Darwin's knuckles, since he was so obviously anxious to persuade his readers of a specific point of view?

Let us return to the actual text of the book. This may well hold the key to a correct understanding of its success.

[50] Ibid., pp.232-233.
[51] Ibid., p.233.

The Introduction and, as we shall see, the rest of *The Origin of Species* contain definite literary elements. If I am correct in assuming that the significance of these elements has been underestimated so far, a host of interesting questions present themselves.

How should we envision the relationship between language and reality? How can we account for the fact that interest in the literary elements of the book — one of the most famous books in the history of science — has been practically non-existent, indeed, that till very recently they have not even been noticed?[52] What are the consequences of their being discovered for the status of Darwin's theory and perhaps for that of scientific theory in general? Could Darwin, in fact, have written the book differently — in a style that would have been less *literary* and more *scientific*?

[52] An example of this recent change is J.A. Campbell (1987). It is significant that he still feels obliged to excuse his interest ("(...) (it) may seem to confuse the provinces of rhetoric and science. (...) (but) even scientific discourse must be persuasive (...)") (p.69).

CHAPTER FOUR

DARWIN AS WRITER

4.1 Various ways of reading a text

There are many different ways of reading, analyzing and evaluating a text.[1] One can, for instance, focus on the *relationship between the text and the world outside it.* This is the case with a scientific text. For a text on natural science the reality beyond the text is the reality of the natural world, and the reader's opinion of the text will be based on the work being 'true': whether it faithfully articulates reality.

Secondly an analysis can be made of *the relationship between text and writer.* In this case the reader determines whether the text adequately expresses the writer, his or her emotions and intentions. Criteria of judgement are, for instance, authenticity and honesty. At present these criteria are rarely used, but literary texts were read in this way for a considerable time.

A third approach is to consider the *relationship of the text to itself,* an approach frequently used today for literary texts. The text is assessed as an aesthetic object, its style is analyzed, as well as the pattern of internal references and the way it creates meanings.

Finally a written work can be read in the light of the *relationship between text and reader.* This involves a rhetorical or 'pragmatic' way of reading, an approach concerned with completely different questions: what is the target group, the readership, what is the author trying to achieve, and how does he or she attempt to attain this goal?[2] Criteria

[1] The study of specifically literary texts has a long history. The inclusive study of texts *qua* texts is fairly recent. See J. van Luxemburg, M. Bal and W. van Westeyn (1982). The interest in scientific texts is growing rapidly: cf. D. Bloor (1976), J.R.R. Christie (1987), M.A. Finocchiaro (1980), J.R. Nelson a.o. (red.) (1987), S. Shapin and S. Shaffer (1985), S. Shapin (1988), G. Marcus (1987), B. Latour and S. Woolgar (1979), A.G. Gross (1990), G. Myers (1990), E. Fox Keller (1985). A seminal work was H. White (1973). An important stimulus is provided by the Society for Literature and Science (founded 1985), its quarterly bulletins and Annual Meetings.

[2] cf.A. van Zoest(1980). In our culture explicitly rhetorical texts – in the traditional sense of dashing oratory addresses to a live audience – are hardly, if ever, found. An exception are advertising texts: they are frankly rhetorical and their rhetorical nature has always been recognized. In the past, rhetorical texts mostly took the form of occasional works – festive addresses and speeches.

used here are the extent to which the author succeeds and the appropriateness of the means employed. This way of reading is nowadays widespread, notably for philosophical and literary works.

Since the relationship between text and outside world is central to a scientific work, such works are read in order to get to know — or to get closer — that reality; or, in the case of scientists, the work is read in order to check if the author's information does indeed may contribute to that goal. A scientific work is expected to have a referential style and structure. Scientific texts are placed in the mimetic tradition: the written work has the pretension of reflecting the outside world. Even if such a work does, at present, not have this pretension — scientific researchers have become very chary of claiming that their theories represent the 'truth' — correspondence to reality is still suggested by the referential nature of the writing.

From a scientific point of view there seem to be only two kinds of texts: scientific, in which style is unimportant, and non-scientific. The non-scientific works — literary and rhetorical or something in between — constitute the research area of literary theorists, who apparently have little interest in scientific texts. Because scientific texts claim to describe the reality outside the text, their style is assumed to be uninteresting. They are thought to be descriptive, objective and deductive, having the form of a monologue. They are supposed to advance relentlessly, step by step, along the path of reasoned argument. In such texts one can hardly hope to find expressions of feelings, questions, exhortations and exclamations, rousing of sentiments or flights of fancy.

However, while reading the introduction to *The Origin of Species* we have observed that the book has a strong rhetorical element. This strikes us as exceptional. Why should a scientific statement of a reality be so rhetorical?

Slowly, however, it is being realized that *all* writings have a rhetorical side — indeed, that a text without a certain amount of rhetoric is unthinkable, for the simple reason that it is characteristic of language to 'form' the speaker/writer and the listener/reader.[3] All words and sentences give form to experience and thought. Together with the style and structure of the text as a whole, the language we speak is to a large extent *constitutive* for the way in which we, human

[3] J. Derrida in particular has boosted this approach. In The Netherlands and Belgium S. IJsseling (1981) advocates a rhetorical analysis of philosophical writings. The representatives of the Strong Programme in the philosophy of science also stress the role of rhetoric in science. cf. D. Bloor (1976). See also note 1 of this chapter.

beings, experience ourselves and reality. The ensuing literary reading of *The Origin of Species* — a reading in which the central question is not so much *what* Darwin wrote (content) as *how* he wrote it (form) — will confirm this constitutive function of language.

But this confronts us with an extraordinary situation. A *scientific* work like *The Origin of Species* constituting the reality it studies — in this case the natural world? If so, could the work still be considered *scientific*? To beg the question: *The Origin of Species* is not scientific in the sense we normally attach to the word. In what sense it cán be called scientific will not be easy to answer.

4.2 DARWIN'S STYLISTIC DEVICES

Darwin was well aware that a simple statement of the facts is not sufficient to convince listeners or readers of a particular point of view. Especially when the point of view is new, a statement is not really convincing until it is put across effectively.

From the start Darwin has managed to build up a relationship with his readers in *The Origin of Species*: by reassuring them as to his scientific qualifications; by making it clear that he will not play tricks on them; by asking them to trust him; but also, for instance, by writing so clearly and extensively that everyone can understand him. In all possible of ways Darwin made his readers feel that he regarded them worthy of his attention. And, indeed, this was a serious matter for him: their acceptance or rejection of his theory would determine whether or not it would become part of science.

Darwin uses all kinds of stylistic devices to convince his readers. Traditionally such devices are divided into more explicitly *rhetorical* methods, directed at the readers in order to get them involved — such as full details, clarity, entertaining descriptions, respect and sympathy for the reader - and more *literary (poetic)* stylistic methods which enrich the writing from an aesthetic point of view — like the use of metaphor and personification.[4] It should be remembered, however, that

[4] For attempts to define 'literature', see: J. van Luxemburg et alii. (1981), pp.19-28 and p.110; on rhetoric, ibid., pp.110-115. See also R. Ingarden (1960), W. Iser (1971), F.C. Maatje (1974), W.K. Wimsatt and C. Brooks (1957). The literature on rhetoric is too extensive to even begin to list. For this study I have found useful: R. Barthes (1970), D.C. Bryant (1965), A.J. Cascardi (1983), J.R.R. Christie (1987), E. Grassi (1980; 1984), P. Hess (1991), W.S. Howell (1965), A. Kibēdi Varga (1976-1977), A.R. Louch (1989), J.R. Nelson a.o. (1987), W.J. Ong (1958), Ch. Perelman (1979), L.A. Richards (1978), R. Weaver (1965), S. IJsseling (1975; 1981). On literary style: J. Cohen (1966), U.D. Boyd (1968), K.G. Hamilton (1963), R. Ingarden (1960), W. Iser (1971),

this division is extremely artificial. The distinction between rhetorical and poetic (literary) texts goes back to Aristotle. Both types were in contrast with scientific texts. Aristotelian rhetoric was the whole system of rules governing good and convincing speech (in modern times, this also includes writing) in day-to-day life, especially in politics; poetics was the theory of literary speaking (and writing), especially for the writer of tragedies. Rhetoric was at the immediate service of mutual communication and discussion in the practical life. Poetry, attempting to express insights into the essence of human existence, was of a more contemplative nature. Rhetorical statements were concerned with facts, circulating in a community. In poetry it was personally tinted experiences which played a central role. However, even in Antiquity both genres had begun to overlap: 'poetic' stylistic methods were used to make knowledge about matters of everyday life attractive and to present this in such a way that it could be received and transferred; rhetoric was sometimes given a poetic slant because aesthetic means were used in speeches and other statements to impress the listener. And yet the distinction between rhetoric and poetry did not completely lose its significance until the end of the eighteenth century.

Personal feelings — with regard to love, for instance — were always placed under the heading of poetry and a less personal genre such as history counted as rhetoric. This personal element, the element of feeling, strongly increased in the poetry of the end of the eighteenth century. Poetry began to find its roots more and more in the lonely experiences and the personal imagination of the poet. Hence poetry became much more important in the Romantic period. At the same time, and for various reasons, classical rhetoric fell into disuse: it was difficult to express new knowledge and new experiences in the old standard formulae of rhetoric. Originality was appreciated more and more, not only in the art of poetry but also in the sciences. And anyone who had learned to look for himself in the modern empirically oriented sciences, no longer wanted to use the old standard formulae. The word 'rhetoric' began to take on the same meaning as 'bombastic'.[5]

But though the rules and formulae of classical rhetoric may have fallen into discredit as a consequence of all this, rhetoric in the sense of a means of communication between writer and reader did not, of course, disappear. In the majority of their works, writers continued to address themselves implicitly or explicitly to their audience. To that

F.C. Maatje (1974), P. Ricoeur (1975), J. van Luxemburg e.a. (1981).

[5] See Ilse N. Bulhof, (1984A)

extent we can speak of specific *rhetorical* and specific *poetical* elements in texts, not only in the nineteenth century but also, to a certain extent, in our time. The difference is that people nowadays are no longer so much aware of the requirements and skills of the process of communication; the art of communicating is little practised any more.[6] In summary, literary and rhetorical elements are today intertwined. This is also the case in a work like *The Origin of Species*: in Darwin's writing the more literary characteristics work extremely convincingly and the more rhetorical elements are extremely literary.

In my discussion of the stylistic methods used by Darwin to explain to his readers his theory of the origin of species and to convince them of its correctness, let me start with the more literary stylistic devices, beginning with metaphors.

4.3 SIMILE AND METAPHOR IN *THE ORIGIN OF SPECIES*

Darwin's capacity for finding images to illustrate what he meant was almost inexhaustible. The presence of imagery or what is known as 'figurative' speech is often thought to be an essential characteristic of poetry.[7] But it is also found in stories, dramatic texts and daily speech — even in a scientific work like Darwin's *The Origin of Species*.

Figurative speech has been ingeniously and extensively classified in old handbooks of rhetoric — which are still used in literary theory. In figurative speech a distinction is usually made between two main categories: on the one hand *metaphor* and *simile*, on the other *metonymy* and *synecdoche*. Since the latter scarcely figure in Darwin's writings they will not be discussed here.[8]

Simile and metaphor are based on similarity. A likeness can be explicitly indicated by the use of the word 'like' as in the sentence 'He fought like a tiger'. Here we are dealing with a simile. Metaphor in a stricter sense is used when the object to be compared is directly replaced by an image, as in the expressions 'evening of life' or 'Mother

[6] With the exception of the United States, however. There students at high school and in their first years of college and university are given theoretical and practical training in communicative writing. Only in politics and the advertising world remained a great deal of awareness of the importance of rhetoric.

[7] J. van Luxemburg et alii. (1981, p.199).

[8] It is sometimes hard to decide whether figures of speech belong to the categories of metaphor and simile (relation of similarity) or metonymy (substitution of consequence by cause or of content by container) and synecdoche (substitution of a whole by a past, parts pro toto). See on this topic J. van Luxemburg (1981, pp.202-201).

Nature'.[9] Let me give a few examples. One of Darwin's most beautiful comparisons is that of the tree as seen in nature with the tree of life. The 'literal' tree that we see growing outside, is compared with the 'figurative' tree of descendance from ancestors and with the Tree of Life. This comparison has a deep meaning for Darwin:

> I believe this simile largely speaks the truth.(129)

According to Darwin the relationships between all creatures of the same class are sometimes represented by a great tree:

> The green and budding twigs may represent existing species; and those produced during former years may represent the long succession of extinct species. At each period of growth all the growing twigs have tried to branch out on all sides, and to overtop and kill the surrounding twigs and branches, in the same manner as species and groups of species have at all times overmastered other species in the great battle for life. The limbs divided into great branches, and these into lesser and lesser branches, were themselves once, when the tree was young, budding twigs, and this connection of the former and present buds by ramifying branches may well represent the classification of all extinct and living species in groups subordinate to groups. Of the many twigs which flourished when the tree was a mere bush, only two or three, now grown into great branches, yet survive and bear the other branches; so with the species which lived during long-past geological periods, very few have left living and modified descendants. From the first growth of the tree, many a limb and branch has decayed and dropped off; and these fallen branches of various sizes may represent those whole orders, families, and genera which have now no living representatives, and which are known to us only in a fossil state. As we here and there see a thin straggling branch springing from a fork low down in a tree, and which by some chance has been favoured and is still alive on its summit, so we occasionally see an animal like the Ornithorhynchus or Lepidosiren, which in some small degree connects by its affinities two large branches of life, and which has apparently been saved from fatal competition by having inhabited a protected station. As buds give rise by growth to fresh buds, and these, if vigorous, branch out and overtop on all sides many a feebler branch, so by generation I believe it has been with the great Tree of Life, which fills with its dead and broken branches the crust of the earth, and covers the surface with its ever-branching and beautiful ramifications.(129-130)

[9] The literature on metaphors has been growing rapidly. Useful for this study have been O. Barfield (1960), M. Black (1962), Th. Bucher (1972), J. Derrida (1975), M. Gerhart and A. Russell (1984), L.C. Knights and B. Cottle (1960), G. Lakoff and M. Johnson (1980), R. Landheer and A. van Santen (1983-1984), P. Ricoeur (1975), S. Sacks (1978), C.M. Turbayne (1971).

The image of the tree representing something different from a tree in the botanical sense has a long history in our culture. It started in the Bible with the Tree of Knowledge from which Eve plucked the forbidden fruit; then there was the tree of Jesse indicating the descent of Jesus. Throughout the centuries the concept of a tree has been used by noble families in the form of a family tree. In philosophy it was used by Descartes, who combined the family tree and the Tree of Knowledge in a majestic vision of the inter-connection and dependency of the different branches of science — with metaphysics constituting the 'trunk' and the practical sciences such as medicine and ethics being the 'fruits'. It is, as it were, inherent in the tree in our culture, to represent something more than tree *per se*.

The tree as a family tree, with a trunk representing the beginning of life on earth and the branches representing the species was therefore not all that unusual: people were familiar with the concept — it was common currency. The new factor was that Darwin compared fossil species to fallen twigs; full-grown twigs that had become branches to extinct species living on in other species; lower offshoots to still extant but archaic forms of animal life; and fallen leaves and twigs which form the earth's crust to the rich, vital, growing and dying natural world itself of which we, too, are part — a magnificent Tree of Life. All of this sprang from Darwin's own imagination. It is a first-rate *poetic* vision.

By using such a comparison Darwin facilitated the reader's attempts to follow his line of thought: the unimaginable — the origin of species — becomes imaginable. This use of imagery was an extremely effective way for Darwin to explain his theory to non-specialist readers. And to his specialist readers too, since it was just as difficult for them to grasp Darwin's meaning as it was for the others.

In addition we may assume that the comparison made it easier for Darwin himself to get a grip on the difficult subject of the origin of species. The fact that he chose this particular image to explain his theory could well indicate that it had actually helped him to visualize his theory.

The comparison which probably plays the greatest (functional) role in Darwin's writing is that which he makes between man and nature. He sees both as makers (producers) of things (products). The whole principle of natural selection rests, in fact, on this comparison. Just as breeders consciously choose good specimens of a particular type of animal in order to mate them and produce good offspring, so does nature 'unconsciously' (by means of the mechanism of the struggle for

existence) 'choose' the best specimens for mating: in the struggle for survival, the bad (who would, in their turn, produce bad offspring) disappear from the scene. For Darwin's hypothesis the metaphor based on this comparison is of fundamental importance, as may be demonstrated by the fact that — together with the struggle for survival — it forms part of the subtitle of his book, the full title being: *On the Origin of Species by means of Natural Selection or the Preservation of favoured Races in the Struggle for Life.* This comparison will be extensively discussed below.

The experience of animal and plant breeders was not common knowledge. Darwin repeatedly expressed amazement at the fact that people were so ignorant of the breeding of superior animal and plant species. He had to explain clearly and elaborately to his readers the significance and practice of what was the most natural thing in the world to breeders: the selection of suitable specimens for reproduction. Only Darwin (with the exception of the Dutchman Donders) had spotted the analogy between the breeding of animals and the cultivation of new crops on the one hand and the origin of new species in nature on the other. Before Darwin no-one had conceived the idea of nature as an organization cultivating her products, the species. By comparing breeder and nature in so original a manner, Darwin put into words what no-one had so far been aware of. By using this metaphor he succeeded in verbalizing a new idea. Darwin's comparison very clearly demonstrates the effect to be gained from metaphor: it reveals something previously unobserved.

The principle of natural selection is only remotely associated with the professional operations of breeders. Darwin:

> I have called this principle, by which each slight variation, if useful, is preserved, by the term Natural Selection, in order to mark its relation to man's power of selection.(74)

A logical conclusion of Darwin's comparing nature to a breeder, was his describing the working of nature in terms of an young active, selective power — a person. Darwin's friend Sedgwick raised objections to the metaphor of natural selection. He considered 'development' a better word, especially since development was recognized by biologists as well as people simply using their common sense. Development, said Sedgwick, takes place according to God-given laws which we can study and understand. Why then introduce a concept like natural selection, which summons up the image of a consciously selecting being, whereas it is, in fact, no more than a question of development and struggle for

existence?[10] In later editions Darwin defended his use of this kind of metaphor by saying that he was well aware that an expression such as 'natural selection' should not be taken literally. But why should we not use figurative expressions? Do not chemists also speak of 'affinity' between different elements?

> (...) but who ever objected to chemists speaking of the elective affinities of the various elements? – and yet an acid cannot strictly be said to elect the base with which it in preference combines.(88)

Physicists speak of the power of attraction by gravity, as a force governing the movements of the heavenly bodies. Surely nobody is against the use of such an expression? The reason why nobody objects to these figures of speech, according to Darwin, is that everyone is familiar with the significance and the implications of these metaphors.

A third important metaphor in *The Origin of Species* is the 'struggle for existence' or the 'struggle for life' which, Darwin said, was raging in the natural world. (Spencer had already called this 'survival of the fittest'.) Many examples show Darwin's plastic use of language:

> (...) how complex and unexpected are the checks and relations between organic beings which have to struggle together in the same country.(80)

> (...) the struggle (between the species of the same genus) will generally be more severe between them, if they come into competition.(84)

> (...) in no one case could we probably say why one species has been victorious over another in the great battle of life.(84)

> (...) each organic being during some season or at intervals has to struggle for life and suffer great destruction.(86)

Darwin's description of the struggle inherent in sexual selection is quite striking. Sexual selection is a particular form of natural selection, resulting not in the death of the loser but rather in the loser producing few or no descendants. But this outcome does by no means reduce the ferocity of the battle, for:

> Generally, the most vigorous males, those which are best fitted for their places in nature, will leave most progeny. But in many cases, victory depends not so much on general vigour, as on having special weapons,

[10] On A. Sedgwick see F.M. Turner (1974, pp.38-67). See for an evaluation of Sedgwick's reaction chapter five note 54 of this study

> confined to the male sex. A hornless stag or spurless cock would have a poor chance of leaving numerous offspring. Sexual selection, by always allowing the victor to breed, might surely give indomitable courage, length to the spur, and strength to the wing to strike in the spurred leg, in nearly the same manner as does the brutal cock-fighter by the careful selection of his best cocks. How low in the scale of nature the law of battle descends, I know not; male alligators have been described as fighting, bellowing and whirling round, like Indians in a war-dance, for the possession of the females; male salmons have been observed fighting all day long; male stag-beetles sometimes bear wounds from the huge mandibles of other males; the males of certain hymenopterous insects have been frequently seen by that inimitable observer M. Fabre, fighting for a particular female who sits by, an apparently unconcerned beholder of the struggle, and then retires with the conqueror. The war is, perhaps, severest between the males of polygamous animals, and these seem oftenest provided with special weapons.(94)

The struggle for existence is a metaphor, except in a few cases where an actual or literal fight takes place:

> I should premise that I use this term struggle for existence in a large and metaphorical sense including dependence of one being on another, and including (which is more important) not only the life of the individual, bu t success in leaving progeny. Two canine animals, in a time of dearth, may be truly said to struggle with each other which shall get food and live. But a plant on the edge of a desert is said to struggle for life against the drought, though more properly it should be said to be dependent on the moisture. A plant which annually produces a thousand seeds, of which only one of an average comes to maturity, may be more truly said to struggle with the plants of the same and other kinds which already clothe the ground. The mistletoe is dependent on the apple and a few other trees, but can only in a far-fetched sense be said to struggle with these trees, for, if too many of these parasites grow on the same tree, it languishes and dies. But several seedling mistletoes, growing close together on the same branch, may more truly be said to struggle with each other. As the mistle toe is disseminated by birds, its existence depends on them; and it may methodically be said to struggle with other fruit-bearing plants, in tempting the birds to devour and thus disseminate its seeds. In these several senses, which pass into each other, I use for conveniences sake the general term of Struggle for Existence.(74-75)

This comment on the metaphor of the struggle for existence shows that Darwin minimalized the importance of his use of metaphors: it was merely a simple way of expressing a difficult concept. His evocative language simplifies not only the language of his treatise but also the concept he is explaining. If this type of simplification is required for his professional colleagues not familiar with a principle like that of natural selection, how much more must this apply to the wider audience of an interested non-professional public.

Another example of a metaphor is the 'geological record' in *The Origin of Species*, an image Darwin had adopted from Lyell. As with the image of the tree, Darwin elaborated on this familiar image. He regarded the geological record as an encyclopedia consisting of many, many volumes, in which the vicissitudes of the earth are recorded. However, the encyclopedia is incomplete, many events have left no record. In fact, only the very last part of the history of the earth has been preserved — the part telling of early forms of life and extinct animals. And of the latter only occasionally a brief chapter remains (perhaps Darwin was referring to the fossils of fauna and flora). Only the odd line has been saved from each page, just as it is only in a few places on earth that a centuries-old fossil bone has been preserved. The tale of the history of the earth is written in a slowly changing language, each word representing a form of life. Just as words change, so too these forms change in the course of time, and are in the end buried in the successive geological strata. This gives the erroneous impression that the various forms of life appeared abruptly on the world scene rather than slowly evolving from one another.

It is amazing how skilfully Darwin used these existing metaphors and similes to develop the implications of a certain image and to exploit it for his own ends. It is as if he allows himself to be led by images like tree, breeder, struggle and record, in order to use them to discover characteristics of the natural world. We could say that Darwin uses his metaphors not only didactically but also *heuristically*.

Other expressions regularly used in natural history such as 'relationship', 'common type', 'fatherhood', 'morphology', 'characters adapting to changing circumstances' and 'rudimentary organs not having achieved full development' are, as Darwin noted, also metaphorical. The word 'fatherhood', for instance, indicates the relationship between a father and his children. Natural historians use the word figuratively to indicate that a fossil animal species is the 'father' of others ('mothers' are conspicuous by their absence!)

Although this was only a figure of speech, yet Darwin was convinced that the theory of evolution would make it clear that those later animal species were 'real' descendants (*children*) of the relevant fossil animal species.(447) The link established by natural historians between relationship in a human family on the one hand and mutual relationship between animal and plant species on the other, would, in other words, be shown to be 'literally true' in the course of his

research.(449) Thus the heuristic function of the images he used was indicated by Darwin himself, even though he did not employ the term.

Darwin wanted his readers to believe that the use of metaphors as a heuristic research method would anticipate the actual research. In the future his images would have to be verified experimentally. The reality of nature as demonstrated in scientific observations and experiments would be used as a touchstone for the truth or falsehood of the images and hypotheses. Objective reality would serve as the anvil upon which the images and hypotheses would be hammered in order to test whether they were true and could be maintained.[11] The images and hypotheses were to be regarded as 'true' when they appeared to accord with reality. But — and that is the crucial question — what is 'reality'?

The usual opinion is that reality exists separately from the human mind, separately from the researcher; it exists, as it were, in itself, it simply is, as it is (it is 'true'); and images, hypotheses and theories can derive their truth from that being-as-it-is (that 'truth'). 'At first' there is an objective, external reality, 'then' we express ourselves about this reality. This has been how people have thought since Plato and most people still think in this way about the relationship between language and reality. But how do we know at any given time whether we do, indeed, know a segment of reality as it exists in itself?

In the last few decades science and philosophy of science have become very cautious about claims to truth. Popper was one of the first to do so. He suggested that all theories, hypotheses and images can in principle be falsified — that they are valid until proved otherwise. In his critical rationalism, theories (insights, knowledge) no longer possess eternal value.[12] Kuhn is even more cautious. He wonders whether the so-called objective reality by which scientists test their theories during research really does come 'first', or whether perhaps it is language that comes 'first'.[13] Or, a third possibility, whether there is perhaps a mutual influence of language on reality and *vice versa*.[14]

[11] The word 'anvil' is borrowed from H. Koningsveld (1976, p.104).

[12] K.R. Popper (1959 and 1963). See also H. Koningsveld (1976, p.104).

[13] Th.S. Kuhn (1979).

[14] Ibid. In 1977 Kuhn wrote in discussing scientific revolutions that at some point the old concepts fail "to fit the structure of the world to which it was expected to apply (...) learning to recognize its defects was necessarily learning about the world as well as about the concept" (p.258). J. Derrida (1975) and the deconstructivist philosophers following his approach question the separation between a reality existing in itself and our language about it: it is simply impossible to tell them apart.

As this issue will be discussed in the last chapter it may be sufficient to say here that Darwin, anyway, boldly assumed that the evocative and imaginative — almost poetic — language of *The Origin of Species* did indeed describe reality. Should this prove to be so, then his language would not really be fantastic and fanciful. Was his language, after all, referential and descriptive, and had those readers who recognized its poetry better become accustomed to it?

Or could it be that 'reality' is 'fantastic'? In a certain sense this is indeed what nature was for Darwin: fantastic in the sense of unbelievably beautiful. But the fantastic beauty of nature was, in his eyes, by no means fantastic in the sense of irrational or incomprehensible. On the contrary, the beauty of nature was the result of extremely complicated, but absolutely logical and rational laws. It was not fantastic in the sense of fantasized, not really existing, a phantasm: nature's beauty, however fantastic, did exist. *What could possibly be fantastic about a reality that really exists and is rational?* Could it be that the real existence and rationality are phantasms? Discussing this question here, however, would anticipate the result of this study.

4.4 PERSONIFICATIONS

Darwin's manner of writing about nature in *The Origin of Species* is surprising for a scientist: he *personifies* nature, and is doing so most emphatically.[15] Since Darwin sees selection by nature as an active principle, nature almost inevitably becomes a concrete and personal figure, a selecting and producing person. For instance, Darwin speaks of varieties given to man *by nature's hand*. When he praises nature for the beautiful things she has brought forth, he adds:

> (...) Nature's productions (...) should plainly bear the stamp of far higher workmanship than man's productions.(90)

Other curious examples of personification are:

[15] cf. also R.M. Young (1985), J.A. Campbell (1987, p.79). G. Beer (1985, 1986, pp.68-72), lists the changes which Darwin made after the first edition to the text of *The Origin of Species* in connection with his personifications of nature. These changes show that Darwin was well aware of the dangers involved notably in the personification of the natural world.

> Nature may be said to have taken pains to reveal her scheme of modification, by means of rudimentary organs, of embryological and homologous structures, but we are too blind to understand her meaning.(442)

> (...) we behold the face of nature bright with gladness (...).(74)

> (...) where trees would have to struggle with other trees.(91)

It sounds as if trees are coming to blows with one another. Darwin presented nature as a person setting strict rules:

> Though Nature grants long periods of time for the work of natural selection, she does not grant an indefinite period.(104)

In this way Darwin wanted to indicate that a species is mercilessly destroyed if it does not lend itself to modification, or if it is less amenable to change than the species with which it is competing.

Darwin personified not only nature but also that which he regarded as the formative principle of nature: natural selection, *vide* the last quotation above.(104) Elsewhere he called natural selection *a power incessantly ready for action.*(74)

Why, he asked,

> (...) should natural selection not be capable of great results by acting unconsciously just as man can do it consciously?(90)

In fact, compared to nature man is at a disadvantage. Man can only act on the external and visible characteristics: nature
Darwin described natural selection as active and alert:

> (...) daily and hourly scrutinising, throughout the world, the slightest variations; rejecting those that are bad, preserving and adding up all that are good; silently and insensibly working, whenever and wherever opportunity offers, at the improvement of each organic being in relation to its organic and inorganic conditions of life.(90)

Natural selection can operate actively like a person. She *is able*, for instance, to change and adapt an insect larva to all kinds of circumstances. In social animals natural selection *adapts* the make-up of the individual to the welfare of the whole community, since this causes the community to make progress.(92) She is not, however, 'capable' of everything: there are limits to her powers, for:

> What natural selection cannot do, is to modify the structure of one species, without giving it any advantage, for the good of another species.(92)

In his closing chapter Darwin once again introduced the anthropomorphic character of natural selection:

> (...) natural selection acts only by short and slow steps, accumulating slight, successive, favourable variations.(435)

This referred to the famous adage *Natura non facit saltum* — nature does not make jumps.(435) In Darwin's opinion the proverb hit the nail on the head, for:

> (...) nature is prodigal in variety, though niggard in innovation.(435)

Darwin also made frequent use of more 'innocent' forms of personification: personifications which do not threaten to get out of hand, which act rather like a cliché and simply remain a figure of speech without influencing the content of what is expressed, for instance:

> (...) geology tells us (...).(124)

> I believe this simile largely speaks the truth (...).(129)

> (...) embryology enters a strong protest against the belief in such abrupt changes.(227)

Besides using the concept of 'natural selection' in the shape of an active human being, Darwin also employed it when referring to the belief (of man) in natural selection as the formative principle in nature:

> (...) as modern geology has almost banished such views as the excavation of a great valley by a single diluvial wave, so will natural selection banish the belief of the continued creation of new organic beings (...).(100)

Here natural selection is used both as personification and as metaphor.

Should we see these personifications — like the metaphors and similes mentioned above — as a rhetorical and literary stylistic device, a teaching aid? Or are they a heuristic aid as well? This would be strange: the age in which it was normal to regard nature as a living and active being was long past. Surely Darwin is not telling a fairy story in *The Origin of Species*? Or is he?

In the next section I would like to examine the effects of Darwin's figures of speech. I shall begin by analyzing in greater detail the basis of Darwin's powers of persuasion. How could a metaphor like natural

selection become such a success with his readers? This was achieved, as we shall see, by Darwin's appeal to his readers experience.

4.5 The effects of Darwin's similes and metaphors: nature and culture

The society with which his readers were personally familiar was used by the writer as an aid to enable his readers to interpret unfamiliar nature. With his metaphors Darwin built a bridge between his readers personal experience ('what is here'), and the processes of living nature ('what is there', the yet-to-be-experienced reality or reality beyond-our-experience). The function of his metaphors is to link 'here' and 'there' by means of a bridge that is actually accessible to his readers: recognizable, imaginable, comprehensible. This can only been achieved by the evocative language of literature.

The very fact that Darwin chose animal and plant breeders as examples to explain how nature works, took their experience as normative for both mankind and nature and succeeded in convincing his readers that the comparison was a valid one, is connected with the increasing technological emphasis on the image of mankind (at least in middle-class circles) in the nineteenth century. Man became *homo-technicus*: a rationally acting producer of objects, including his own life. He became an autonomously acting subject. In a world in which social patterns were no longer permanently laid down, in which society was in motion, where nobody had a fixed position any longer, the individual could, and indeed had to, use his own choices and decisions in order to secure his place in society. The independently acting, thinking, deciding and choosing individual used his own judgement to shape his own existence in this chaotic world: 'created', 'made' or 'produced', as it were, his own self. Those who succeeded in making a career have been able to arrange matters in such a way that they have become lord and master over the circumstances in which they live — within the bounds of possibility, of course, for certain bounds are pre-determined and immutable: place, time, social class, the very fact of birth and death, and so on.[16] Darwin was not selecting a random example from the world he lived in: he carefully selected for his comparison those elements which, in his opinion, show what man

[16] We find the image of man creating himself articulated very well by the German philosopher W. Dilthey. cf. Ilse N. Bulhof (1980, pp.155-158).

'actually' is: a creating or producing subject. We might say that Darwin used carefully selected experiences as his starting point.

In *La formation de l'esprit scientifique* (1938), Gaston Bachelard contended that there is a gap in science between experiential knowledge and scientific knowledge (*rupture épistémologique*).[17] A study of Darwin's metaphors shows a different picture: his vision of the origin of species developed from the commonly held experiential knowledge of his time. However, since this vision was concerned with an experience as yet not clearly articulated, the experiential component was not immediately obvious at the time. Only a retrospective study of the cultural context makes this clear.

The typical nineteenth-century self-experience of people being rational, selective and producing individuals was subservient to the acquisition of power. Darwin appealed implicitly to this self-experience when he suggested that the power of man would be the key to understanding the work of the breeder. The breeder actually makes the races, he brings them forth, he produces them.[18] What was experiential knowledge — know-how — for the breeder became, *in Darwin's interpretation* of the breeder's work, knowledge deliberately used to attain a goal (good descendants); *experiential knowledge* became *technical knowledge* serving the producer's ends.

Darwin subsequently read his interpretation of the phenomenon of man also in living nature as a whole. For many years he tested his interpretation of productive man and nature and wrote it down. In other words: he *interpreted* nature in accordance with his own interpretation of man. Since his readers could accept his concept of man and society because it corresponded with their own more or less conscious experience of life at the time, it seemed only natural for them to accept Darwin's description of nature's productive selecting process. By the appeal to the experience of the readers, the text became recognizable and comprehensible. The very fact that Darwin's text was recognizable contributed in no small measure to his hypothesis being seen as reasonable and acceptable.

Darwin made frequent reference to the social and economic circumstances of his age. Expressions like 'struggle for life', 'war of nature', 'economy of nature', 'competition' and 'competitors' come straight out of nineteenth-century liberal economics, in which

[17] On this point see H.A.M. Manschot (1980, pp.44-62).
[18] O. Duintjer (1983).

competitors engaged in life-and-death struggles, and talented individuals used their own powers in attempts to gain riches, power and position. It is no accident that 1859 saw the publication of Samuel Smiles' book *Self-Help*.[19] Here we find the same image — of Victorian society — as Darwin sees in nature. According to Smiles, the shining example of the self-made man was the builder of the first steam engine, George Stephenson, who started life as a blacksmith. Smiles had previously published a biography of his hero (1857). Like *The Origin of Species*, *Self-Help* was an extraordinarily popular book: twenty thousand copies were sold in 1859 alone, and towards the end of the century the total sales had reached close on a quarter of a million; it was translated into many languages. The first sentence runs: *Heaven helps who help themselves*, and the message of the book is that most people can manage very well, and can even make spectacular progress, provided they have the will to do so — if they are prepared to develop themselves after work, are prepared to seize every opportunity to study, and make the effort to learn the social graces necessary for life in a civilized society.

Darwin himself had been greatly stimulated by Thomas Malthus' thoughts on human fertility.[20] Mankind is multiplying so fast, according to Malthus' calculations, that food production cannot keep up, with the subsequent result of overpopulation and poverty. Malthus concluded that to attain a reasonable standard of living, man must produce either more food or fewer children. When Darwin read this, the conclusion came like a bolt from the blue. He transferred the notion from the world of man to that of animals and plants, where the alarming phenomenon pointed out by Malthus was even more strongly apparent. For the animal and plant world there could be no question of deliberate, i.e. planned, artificial increase of food production, nor of sensible limitation of sexual activity (*prudential restraint from marriage*).(75) Animals come together indiscriminately in their mating season, and plants multiply at random. One species may multiply more quickly than another, but it is certain — as Darwin understood after reading Malthus — that not all born creatures can remain alive, for the world would be unable to contain them.

[19] J.H. van den Berg (1984, pp.114-117).
[20] On this point see M.J.S. Hodge (1974, pp.16-17).

> There is no exception to the rule that every organic being naturally increases at so high a rate, that, if not destroyed, the earth would soon be covered by the progeny of a single pair.(75)

Does this passage contain a faint suggestion that the principle of birth control is typical for strong-willed people governed by reason: the educated and civilized middle classes?

Besides the nineteenth-century individual, acting consciously and rationally, we also find a collective subject in Darwin's book: the group of inventors of ingenious machinery. It was the age of great technological invention which had begun to mechanize life not only in the factory, but also in the home and in the city (train, tram, steamship, sewing machine). In 1851 the first world exhibition, the Great Exhibition, was held in the purpose-built glass and cast-iron Crystal Palace, where wonderful machines were on display. Many visitors were deeply moved by such ingenuity, so much labour-saving equipment and such great progress.

In the nineteenth century it was felt that an invention like a train or a sewing machine does not come into being just like that: something so ingenious is not born from the inventor's brain like Athene from the head of Zeus (or the world from the hands of God?). Inventing some good thing, which can also be produced — in fact, mechanically *re*-produced! — at a later date, is a process requiring time. This we also find in *The Origin of Species*. Many (anonymous) people try their hands at the first prototype of an invention over a long period of time; before the prototype is really 'finished', all sorts of changes (modifications) and improvements are made to the original:

> (...) any great mechanical invention is the summing up of the labour, the experience, the reason, and even the blunders of numerous workmen (...).(447-448)

Making an ingenious product like a train or a sewing machine is accomplished inch by inch. Seen from the machine's point of view, it is as if it were 'growing' or 'developing'. During this process the machine develops slowly from non-existence (out of the darkness or from behind the scenes) to existence (into the spotlight of the world

stage); step by step it is hauled out of the darkness and into the light, brought forth, produced.[21]

According to Darwin, the same rule applying to material products, applies to scientific theories which, after all, are intellectual products, products of the human brain. Theories also require long periods of labour on the part of the thinker or the author before they are 'complete'. Darwin knew what he was talking about: he had worked for years on his theory — the original idea dated from 1837 — and even now, as late as 1859, it was not yet 'complete'. Indeed, the theory still had to be tested in the practical world of biological research to see whether it could claim to be a good product or whether adjustments still needed to be made. Darwin recounted that he had only rarely conceived an idea that had not needed subsequent changes, or adjustments on many points, or had to be 'modified' (Darwin often speaks of 'modifications' of organic structures).

As with inventions — a machine or a theory — so too with animal or plant species: they do not come 'ready-made'. The idea that part of an animal's body, could appear instantly in its present state of perfection is as unlikely as the idea that a complex machine could be invented instantaneously in its final state of perfection.

> It seems as improbable that any part of an animal should have been suddenly perfect, as that a complex machine should have been invented by man in a perfect state.(58)

There is no room for miracles in the human world. Man can only make a complex object or theory by a long process of development. And God? Does not everything point to the fact, that even God himself did no more than create an initial situation with development potentials, a primeval idea or starting point which then gradually developed without his direct intervention? After the act of creation nature, so to speak, took over production from God after the act of creation, just as a team of workmen takes over the inventor's initial prototype which represents the creative genius at the start of the production process.

According to Darwin, every living creature and all the complex structures and instincts that we find in nature came into being in exactly the same way as ingenious machines: gradual accumulations of small technical devices. An animal (and an organ) are *the accumulation*

[21] For Darwin the machine was first and foremost still a product or an artefact. Products such as we know them, the mass output of machines, was not yet part of his world view; consumer goods were hardly known in 1859.

of many ingenious inventions. Just like a complex man-made product, every product brought forth by nature has a long previous history — and this applies even more to the complex products of nature like the higher species.[22]

The making of such products requires hard labour; a great deal of drudgery must take place behind the scenes, on the work floor, over a long period of time. In the nineteenth century the *time* factor appears on the horizon to accompany the *labour* factor. A product implies working time and workforce — work that is hidden from the view of subsequent users and consumers: work in the factory and at home, hidden, kept at a safe distance, anonymous and unacknowledged.

According to Darwin, the accumulation of ingenious devices leading to the machine as its final product is not a matter of blind chance; at every stage it is accompanied by thought. Even if the inventor has initially no definite idea of his final product, what it will look like, or what sort of modifications to the original prototype will be required, he will still be able to assess which modifications can be useful and which not. He will remember the useful changes. For memory is one of the hallmarks of reason: reason consciously holds on to what is good and does not forget nor disregard what the past has taught. In the nineteenth century the struggle of reason (memory) against time, and especially against forgetfulness, became an important subject for reflection. Remembering is no longer primarily memorizing. Remembering comes to mean above all the capacity to consciously hold on to good experiences and to do something with them. Because of this, reason is stronger than time. Thanks to memory, reason can conquer time by saving the good experiences — storing them in the mind — even though time passes, and with it the experience as such.[23] Thanks to human reason, which man uses *consciously* in contrast to animals, a machine can gradually be improved or 'grow'. In a parallel process, an animal species can also 'grow', even though this particular process does not involve a conscious power of reasoning, which guides and evaluates the process of growth. In the unconscious 'growth

[22] In *The Capital* (1867) Marx pointed out that Darwin realized how during the eighteenth century technological inventions were not the work of one single person. Marx spoke of Darwin's 'history of natural technology'. (Personal communication by Henk van den Beld, Nijmegen, The Netherlands).

[23] I have delineated the role of memory problem in "Persoonlijke weerbaarheid als psychotherapeutisch doel in een post-moderne maatschappij" (Personal self-defence as psychotherapeutic aim in a post-modern society), in *Psychotherapie na 2000*, Nederlandse Vereniging voor Psychiatrie, series 7, 1984.

process' or genesis of the species, experiences or useful modifications are incorporated in the same way. Each living creature we encounter in time, in nature, including ourselves, is *qua* structure a combination of modifications applied at some point of time in the past, modifications which this creature has been able to conserve and incorporate into its very system.

And thus the human self, man as an individual, also 'grows' — in his case a conscious growth. The nineteenth century saw the individual as a human being with an individualized inner life based on personal experiences.[24] The accumulation of small changes or modifications reminds one of the 'growth' of capital: people save, bit by bit they lay money aside in their coffers until a large amount, a capital, has grown which they can use to some purpose.

The metaphors used by Darwin blur the familiar distinction between literal and figurative, between 'real' and metaphorical use of language.[25] They cast doubt on the clear distinction we make between literal and figurative speech — and consequently also between a human, cultural world and a world outside man, the so-called natural world. Darwin identified and qualified the world 'outside' by means of images and expressions borrowed from the cultural world 'inside' — and precisely because of this the 'outside' world is, in fact, no longer a real 'outside'. The world of culture and the world of nature overlap and constitute one single whole. *But in that case there is no longer any real 'inside'*: the 'personal' world of experience (with its concomitant language) of speakers and listeners, of writers and readers, is no longer a private possession or a specifically human terrain situated within the larger territory of the non-human reality. There is a constant process of *interaction* and *interchange* between 'outside' and 'inside', between non-experienced (and unnamed) reality and experienced (and named) reality. Perhaps the image of a soccer match can illustrate this interchange. Two teams, red and white, are playing. Before kick-off and after the final whistle both clubs can be clearly distinguished. Red here, white there. We are here, the others there. Once the match begins, red and white start to mix. And it is, in fact, from this activity that the

[24] Are we to regard the psychological development of the individual as growth in a figurative (or metaphorical) sense – because it refers, for instance, to an invisible inner growth process? But, we can continue, is the growth of plants, for example, a literal growth? Is it visible? And what are we to think of the growth of the species?

[25] cf. also: the tree of live. pp.62-63 of this study. For examples of metaphors in other fields of study see R.L. Heilbroner (1986), D.N. McCloskey (1985) (economics); H. White (1972) (history); G.H.E. Russelman (1983), P. Vroon and D. Draaisma (1985) (psychology); C.J.M. Schuyt (1982) (social-science); G. Canguilhem (1975) (biology).

clubs derive their right to exist: soccer clubs exist to play soccer. We could say that in his use of language (his language activity, his *language game*) Darwin allows 'inside' and 'outside', 'we' and the others, speakers and the non-speaking, to run together, to mingle with each other.

Thus, according to Darwin, mankind and nature 'produce' in the same way: gradually — the only difference being that nature does so unconsciously, mankind consciously. Contrary to mankind, nature has no critical faculty which could implement changes consciously, swiftly and efficiently. However, and again contrary to mankind, nature has time on her side. Due to the time factor nature can eventually achieve the same type of result as consciously assessing and producing mankind achieves in a relatively short time: a high quality product. Slow and steady wins the race; the good modifications are victorious in the struggle against eroding time and against other modifications: they 'survive'. So the same principle of selection used by plant and animal breeders works in nature. Only the form is different. In man the form is that of a conscious choice based on assessment; in nature the form is that of the struggle for survival by means of the mechanism of the struggle for survival. An extremely effective selection!(87)

By using his imagination, a human being (a breeder) can imagine, design, create a wonderful animal in his mind: a fairy-tale beast even more beautiful than a peacock. But in the real world a human being (a breeder) cannot just pull new varieties out of a bag: he cannot create them from nothing. He can only produce them by a long and laborious process, or to recapitulate with Darwin: by deliberately leading the variations in a given direction, by retaining them, by selecting the correct breeding animals and by combining the variations thus obtained.(87)

Nature too selects, chooses, acts, though the action is unconscious. But, one may ask, is unconscious action really action? In our present day the answer would be negative. Nature's action is a quasi-action. Similarly, in our opinion nature has no ratio, no reason, only a quasi-reason. The elements which, in nature, enable us to speak of (a kind of) action and of (a kind of) reason, are precisely those which Darwin regarded as the factor that man and nature have in common: their ability of holding on to what is profitable through the passage of time — indeed, even against the passage of time. Darwin considered this

similarity between man and nature so important, that he could disregard the difference between conscious and unconscious.[26]

It would seem that man, deliberately making his choice, judiciously retaining the useful modifications, outranked nature in her unconscious process of choosing. Until Darwin appeared on the scene the superiority of man over nature had been *communis opinio*. Because of his faculty of reason man had been considered by pagan and Christian philosophers to belong to a higher order — more capable and more powerful than the rest of nature. In the romantic period it was even thought that man could surpass nature by the quality and beauty of the products he made as artist. Whereas for centuries art had adhered to the mimetic tradition (inspired by Aristotle) and imitated nature (*natura artis magistra*), it began to be felt at the end of the eighteenth century that imitation was uncreative and stupid. Anyone wishing to count in this world, had to be original and invent for himself whatever he wished to make (for example as a creative artist).

But Darwin disagreed: in his eyes it was nature that was mightier than man. Not because nature is more clever or more creative, but because nature has more time at her disposal. Human life is short, a human being has too little time to accomplish very much (Francis Darwin wrote that his father had an enormous respect for time, that he never forgot how precious time was!).[27] Not only does a human being have too little time, but in addition he is sidetracked and led astray in his activities by all kinds of distractions. One such distraction is due to the fact that man can perceive only the outer appearance of things, and appearances can be deceptive. In choosing animals for breeding, for example, breeders can only judge their external characteristics; they are unable to see the internal organs hidden behind the external appearances. And thus breeders can make mistakes

[26] We can also 'read' the transfer, as found in Darwin, from real and conscious to non-real and unconscious acts with twentieth century eyes. We can then 'see' that the act of producing, as it takes place in industrial manufacture, occurs for the greater part in the form of unconscious acts, just as seen by Darwin in nature; production results from actions of industrial workers who have no notion of what the product resulting from their joint labour is. At present, to a greater extent than in Darwin's time, production is industrial production, i.e. an act of 'making' with the aid of anonymous labour. In Darwin we can observe how, in the nineteenth century, (real, conscious) making and acting was disappearing from many people's sphere of action.

[27] Ch. Darwin (1958c, p.97).

in making animals: what looks good and beautiful can produce bad results.[28]

Quite apart from inability to perceive the inner world of animals, people are also distracted by their short-sightedness: they often look no further than their own self-interest and thus lose sight of the ultimate goal, for example the animal they want to create. Or they can lose themselves in other matters. Lastly, man can do far less than nature as regards the producing of new species, because they lack the possibility of experimenting with breeding of new species on a worldwide scale.

Everything is quite different in nature: outward appearances do not deceive her:

> Nature (...) cares nothing for appearances.(90)

Nature works on the animal's insides:

> She can act on every internal organ, on every shade of constitutional difference, on the whole machinery of life.(90)

She has been doing so continuously, century after century. Compared with the working of nature, that of man pales into insignificance.How fleeting are the wishes and efforts of man!

> How short his time! and consequently how poor will be his results, compared with those accumulated by Nature during whole geological periods!(90)

Moreover nature seeks only the welfare of her 'products': her work is completely disinterested.(450)

No wonder nature's products are of much better quality and have, as it were, more 'character' (*truer in character*) than the products brought forth by man. They are also much better adapted to circumstances; they are simply better made:

> Can we wonder, then, that Nature's productions should be far 'truer' in character than man's productions, that they should be infinitely better adapted to the most complex conditions of life and should plainly bear the stamp of far higher workmanship?(90)

[28] When we think of people and their 'inside' we are, in contrast to animals, not referring to their organs but rather to their figurative 'innermost part': the world of their thoughts and feelings. This manner of speaking could never have been devised if organic beings had not first become situated in time, shot through with time – as is described by M. Foucault in *The Order of Things*, 1966.

Darwin has made it quite clear that nature is not a creator calling forth creatures out of nothing. Only God can do that. Nature is hardworking, she produces steadily. But what sort of producer is she? Not a God, of course. Nor indeed what nature had long been regarded to be: a mother bearing children. Nor an artisan like a goldsmith or an embroiderer, since handicrafts involve products made according to a design. Such a design is lacking in the development of nature. Nor is nature a freely creative artist, a notion that had been entertained in the romantic period. In Darwin's scheme of things nature's products are by no means 'free creations', no works of art, no products of a free, imaginative, original mind.

So if nature is not a mother, goldsmith or embroiderer, nor a free artist, to what can she be compared? To a machine. Nature brings forth her products without ever being distracted from her task, untiring, without regard for persons, blind and cruel — in one word: machine-like, mechanical. Here we must realize that for Darwin the words 'machine' and 'mechanical' had not yet acquired the negative overtones which they have obtained since. The product of a machine, according to Darwin, is much more regular, much more 'perfected' one could say, than products made by human hands. We find in Darwin's book no nostalgic reverence for handiwork. The stitches made by a sewing machine are much more regular than those made by a seamstress. No matter how expert the needlewoman, her work still has something of the human touch, of imperfection. The sewing machine sews away imperturbably: fine material, coarse material; good cause, bad cause; good working conditions, unacceptable working conditions; skilled or unskilled labour — the sewing machine sews. A factory worker has no style of his or her own, but produces unimaginatively and without any personal commitment. It is exactly the same with the whole *machinery of life*(90): natural selection runs on mechanically:

> (...) silently and insensitively working, *whenever and wherever the opportunity offers* (Darwin's emphasis) at the improvement of each organic being in relation to its organic an inorganic conditions of life.(90)

Nature as a machine — it sounds alarming. Darwin was aware of the cruelty of nature and shocked by it. Nonetheless his predominant feeling was one of wonder at a nature machine capable of producing such wonderful creatures as the higher animal species. In others — like Huxley — dismay was predominant.

The appeal to everyday and specialized experiential data suggests that in *The Origin of Species* we are dealing with a realistic text — and

by this we mean, to use the technical term, a *referential* text with a *discursive* structure — and clearly not with a literary work.[29] This suggestion is correct: *The Origin of Species* is no work of *fiction*, at least not in the sense that it is a work invented by Darwin out of the blue, a fantasy existing only in his mind. But before stating that *therefore* the book is dealing with reality, as we would expect of a scientific work, we need to ask ourselves once again what 'the' reality stands for in this case: is it the reality of living nature? A hundred years later, everyone understands that it is highly unlikely that 'nature' really is as it happened to appear in the mirror of nineteenth-century Victorian society and/or that of liberal England. Besides, what could be meant by 'Victorian society'? The society of old-fashioned clergymen like Klönne or Becker, or, in England, Bishop Wilberforce? That of a man like Sedgwick who, like the clergy, was horrified at Darwin's book? Or that of the socialists, atheists, freethinkers? Is there such a thing as 'reality', 'nature', 'Victorian society'? What does it mean that everyone seems to have his or her own reality, nature or society? These questions will be dealt with in chapters five and six. In the present chapter I would like to study more thoroughly the role of Darwin's metaphors.

The experiential data we find in *The Origin of Species* are, as we have seen, not only 'observed' and *expressis verbis* ascertained ('scientific') data or 'facts' derived by Darwin from the world of plants and animals, but also everyday facts, generally accepted at the time. It is precisely these experiential data derived from ordinary life that rendered it possible even for readers unschooled in biology, to find their way in the text, to *recognize* themselves in the book. Darwin's appeal to experiences that were as yet largely unconscious, but were rendered conscious by this very metaphor, constituted the fascination his language had for his contemporaries.

In so far as metaphors occurred at the time in traditional rhetorical exposés — political speeches, sermons, celebrations — they were often *clichés*, household images. They acted as didactic aids. They illustrated a point contained, as it were, not only in the head of the speaker/writer but also in that of the listener/reader: writer and reader already possessed the cliché in their mind and it needed only to be referred to in their mutual communication. Suitable metaphors for this task must be taken from familiar experiences, otherwise they would not clarify.

[29] In this regard A. van Zoest (1980) speaks of a work of 'non-fiction' (Dutch: 'niet-fictie').

On the other hand, metaphors used in an attempt to clarify *new* experiences first exist only 'in the head' of the writer. He of she must subsequently attempt to evoke the same image in his or her readers — he or she must evoke the image in their heads *ex nihilo*. If a writer succeeds in doing so, readers have the feeling that they understand what is read: true communication between writer and reader has been established.

The creation of new images, seeing unusual images never before alluded to, is said to be characteristic for the work of poets and writers of literature. Poetic *new* metaphors have the effect of *forming* the mind of the listeners/readers, since they make them see what the speaker/writer can see. Poetic new metaphors, one could say, are used in a discourse that is *rhetorical* or persuasive (formative of the reader's mind. Think of *The Origin of Species*) in a constitutive, productive, *creative* or poetic way. The discourse dealing with *new* matters is *inevitably poetic*, since it has to work with wholly new material and new images. Such a discourse can deal with subjects which we normally do not associate at all with poetry or literature, and not even with rhetoric — for instance, a biological work dealing with the origin of species. The traditional separation of rhetorical and poetic, and even scientific texts, is breaking down.

Because he rendered the process of selection visible and imaginable by means of the comparison drawn between nature and breeder, Darwin appears simply to *support* his argumentation. Only a closer look reveals that the actual comparison *constitutes* the argument. Indeed, only if Darwin would have convinced the reader that the comparison is valid the analogy would turn into a proof: if things really are true in the case of the breeder, then too this 'must' apply to in nature.[30] Darwin thought at a very early stage that the comparison could easily be valid and initiated a lengthy, systematic and specific study in order to test his idea (the hypothesis). The results convinced him that it was correct: the comparison did indeed appear to be valid, the metaphor worked. Now the readers of his book would have to test the hypothesis. But how? By reading and thinking along the same lines, a kind of experiment in thought? Or by actually conducting experiments themselves? It soon became apparent that people agreed with him even without the support of scientific experiment: the consensus was that the (cleverly constructed) comparison was indeed valid.

[30] K. Bayertz (1985B). See also on reasoning by analogies: K.D. Knorr-Cetina (1981).

We have seen above that Darwin used his metaphors and similes not only as pedagogic but also as heuristic aids: he allowed himself to be led by certain images (tree, breeder, struggle) that might help him to discover certain characteristics of the natural world. But it was precisely these images which blurred the boundaries between nature and culture: we have also seen how Darwin was enabled by his metaphors and similes to link the 'here' and the 'there', 'culture' and 'nature' — thereby obscuring the presumed distinction between the two.[31] But is 'linking' an appropriate term in this context? The image of a bridge linking two sides would still leave us with two entities. Should we perhaps use another image and say that with his metaphors Darwin has 'introduced' a hitherto hidden aspect of reality into man's world of experience? But this image again creates the impression of an already existent separate 'there', which, by means of the metaphors acting like binoculars, is brought 'closer'. However, Darwin's metaphors were *productive*: they created a *new* (experience of) reality. But when the question is posed as to what exactly is meant by saying that metaphors can be 'productive' in the natural sciences, or how a scientific researcher can 'create', there is no easy answer.

Let me begin by suggesting that as far as the productivity of metaphors is concerned, we should wonder whether they *clarify* what has always existed or *create* that which was not previously apparent. A metaphor has sometimes been compared to a lens, clarifying what already is.[32] Though present, the metaphor appears not to be there: as transparent glass it is *invisible*, just like the eye. If a metaphor is interpreted as a lens, there seems to be no language mediating between what is 'seen' and what is 'known': the metaphor appears to be speechless.

This was, until recently at least, also the basic assumption in scientific research: the presupposition underlying the development and use of scientific instruments (material instruments) has always been that the reality which they attempt to render visible is ready (and finished in itself) to be seen by human beings. If only we had sharper eyes or could design better instruments, laboratories etc., we would be more able to see that which lies 'on the other side'. Like scientific instruments serving to render visible (and to clarify) what is, metaphors were considered, as it were, instruments of language: *instruments-in-words*.

[31] cf. see p.78.

[32] See Ilse N. Bulhof (1987). For a good discussion of microscopes, see I. Hacking (1983)

A metaphor like 'nature which selects', however, cannot be compared to a lens: on closer inspection it is not invisible, not even apparently so. In fact it is most emphatically present. It was certainly noticed by some of Darwin's critics, and Darwin himself was very much aware of it. This metaphor, this new and ingenious image conceived by Darwin, cannot be said to elucidate what is already present, as if it were a magnifying glass or a telescope. The metaphor *expresses* in words that which, according to Darwin's interpretation of what he sees, is. It gives shape and form to what has de facto *become* more and more present in our human world, our culture, or, to put it another way: to what de facto *has become* 'reality' *thanks to the metaphor's mediation.*[33]

Such form-giving by means of words and images to what subsequently has been made present in our world does not necessarily constitute a *deformation*, a distortion. The belief that language would distort is precisely the indication of a preconceived belief in a reality existing separately from us, observers, a reality that we can study and which could be directly known, — known, without language, without our images and words.

Because scientific instruments have been regarded, at least until recently, as magnifying glasses rather than as interpretative devices, the same happened in the case of metaphors, thereby obscuring the productive function of both. The feeling persisted that we were looking through the metaphors at a world beyond. But in that case the metaphors are no longer experienced as metaphors ('imagery'): the lenses which enable us to see (observation, perception, vision), are no longer distinguished from the very eyes of the beholder. We 'literally' see before us what we see (the struggle for survival, for instance). We have the deceptive feeling that what we see with 'our own eyes' must indeed be as we see it 'ourselves'.[34] We forget that we, humans, see the world as language — especially metaphors — makes it appear to us.

[33] In *Darwin's Plots* G. Beer sometimes appears to assume that Darwin was describing nature: "It took a hundred years for Darwin's projections, his 'fictions' or theories, to be thoroughly authenticated empirically. But the accuracy and scope of his observations were such, that they carried convictions as scientific explanations long before they could be proved".(51) "Darwin did not invent laws. He *described* them".(51) On the other hand, she writes that Darwin 'created' his version of the origin of species: "the power of his writing and the novelty of his narrative make it appear that Darwin, man's representative, has as much *created* (my *italics*) as described".(103)

[34] E. Jones (1989).

Scientific texts written by innovative researchers embody their authors' acts of creative expression[35]. They embody the creative way in which the latter express their visions, their interpretations of the situation at hand. Acts of expression have two aspects: on the one hand they express the thoughts and feelings of the speaking or writing subject who transfers meanings to other subjects, fellow humans. On the other hand, acts of expression show intrinsically what the discourse is about, making manifest or disclosing reality. On both accounts innovative scientific texts are comparable to works of art. Expressive language in *art and science creatively mediates* reality.

In order to become aware of the productive effect of metaphors we need not consult science and attempt reflection the function of a material- or word-instrument in a scientific study.[36] We can also simply observe their effect by looking at the way metaphors are created in the language of daily life. After some time the surprising and novel effect of a metaphor has worn off; by habituation we forget that a particular image once was an ingenious discovery — that it is a metaphor. Literary theory (metaphorically) refers to this process of forgetting as 'dying of metaphors'.[37]

Apart from having creative possibilities — rendering reality visible through images (metaphors) — language can also kill: dead metaphors are no longer experienced and recognized as such. Reality then comes to be seen as the metaphor expresses it; the language then no longer 'speaks' or 'lives' as language: it has lost its power of expression. Reality is fixed or *frozen* in accordance with the pattern of the language. When the poet, creative user of language *par excellence*, uses figurative language we realize immediately that we are dealing with imagery. When we read 'literary' works, original metaphors and fine images are among the principal sources of the pleasure of reading. Some of these metaphors pass into daily patterns of speech and are then no longer the object of special attention. Who would still realize the metaphor when having 'ground-less' fears? Who is aware of the

[35] G. Beer suggests in *Darwin's Plots* that the distinction between scientific work and the creation of fiction is not absolute, since creating theories in science and the creation of fiction have a great deal in common. She adds that there was a greater awareness of this in the nineteenth century than in our day. In this regard on can think, in The Netherlands, of F. van Eeden and his remarkable essay "De redekunstige grondslag van de verstandhouding" (The rhetorical basis of understanding).

[36] I. Hacking (1987).

[37] Ilse N. Bulhof (1987, 1990).

imaginative quality of a phrase like 'natural products'?[38] Daily speech is filled with this type of 'extinct' metaphor. In his essay *Über Wahrheit und Lüge im aussermoralischen Sinne*, Nietzsche wrote that practically all language was originally metaphorical.[39] A metaphor can be pronounced dead when it is found listed in the dictionary as an ordinary word or expression.

The same phenomenon of the death of metaphors and the freezing of reality along the pattern dictated by metaphors, can also be observed in science. Darwin's description of the grim struggle for survival in the natural world is a first-class example of the process whereby metaphors are forgotten in science. We recall how, when *The Origin of Species* was first published in 1859, Darwin himself was still aware that the 'struggle for life' did not 'literally' exist, could not be seen, noticed, observed; how he seemed to excuse himself to the incredulous reader who thought the term a little too fantastic, by pointing out that he was using the term 'in a large and metaphorical sense'. But once the general public had learnt to see through Darwin's spectacles, to see nature as a theatre of war where all living creatures were fighting a life-and-death struggle, then the readers could 'literally' see the struggle before their very eyes and it was no longer realized that a metaphor was involved. It did not take long before the struggle was seen as being fought not only between the species, but also between stars, between philosophical systems, projections in nervous pathways, the subconscious and the conscious, rich and poor, and primitive and civilized races.[40]

Another striking example of this type of forgetfulness is the materialistic — but *au fond* poetical — concept of man in anatomy, physiology and association psychology of the end of the nineteenth century: man as a composite collection of bones, tissue and nerves. Physiologists believed that some people, women and artists for instance, had fine, gossamer-thin nerves, they were 'highly-strung'. Unfortunately this made their nerves an easy prey to damage or confusion, causing nervous diseases. A possible cause of the malfunctioning of nerves was the memory of a painful incident, making such 'a scratch' on the nerves that the memory was not only unforgettable but became an 'idée fixe'. Other people, however, had

[38] cf. also G. Beer (1985, p.77): "The concepts of evolutionary theory have shifted the weight of words in common use: words like development, generation, variety, inheritance, individuals, kinship, transformation".

[39] F.W. Nietzsche (1965B).

[40] Ilse N. Bulhof (1983, pp.127-130).

nerves of steel; they could easily meet the demands made on them by the struggle for survival and the hectic modern lifestyle. A few people had a knack, 'a bump' for mathematics, a wonderful asset. The nervous system — and especially the brains — of the criminal was defective: it contained curious twists. When we read the writings of that period everything is made 'visible' — it is very easy to imagine or visualize this concept of man. But the scientists of the time did not consider themselves to be visualizing anything. The microscope showed them quite 'literally' the twists and bumps in brain and nerve cells.

It is as if speech automatically loses its metaphorical quality in the course of time, is depleted of its power of expression, its creativity, unless the words are continually re-confirmed in their original power and significance in the course of special ceremonies, social and religious rites, for instance, or by good teaching.

Once speech has lost its mediating creative (constitutive, performative and expressive) power it becomes conventional. Linguistic conventions make communication in society possible. Without such conventions — scientific and otherwise — we cannot live, dependent as we are on social contacts. The scientific fixations, freezing reality in a certain way, defining what for us will be 'reality', or 'literal truth', can be just as imperative for the social life of our secularized world, as the sacred religious fixations were to earlier times. But it is important that we continually realize — or refresh our awareness of that realization — that when we speak in such fixations we are essentially making use of images, conjectures, interpretations; *that 'reality' may not be as real (or 'literal') as we think.*[41]

We have seen above that the effects of Darwin's figures of speech *in The Origin of Species* are considerable:

1. *The implicit appeal to the reader's experience* — which is mainly couched in metaphors and similes — gave the text its effectiveness. But no-one was aware of that effect: the readers imagined that they were convinced of the correctness of Darwin's hypothesis on the basis of the factual material so skilfully processed by the author.

2. Because of Darwin's lucky choice of imagery, he was able to convince his readers of the correctness of his hypothesis. *Darwin's principal success was due to his performance as a writer.*

[41] cf. O. Barfield (1960), J. Derrida (1975). For another view cf. G. de Vries (1990; see note 54, chapter five of this study).

3. By the skilful use of his metaphors he *convinced* his readers that *his* account of the origin of species *was not based on imagination but on reality*, no matter how unlikely it may initially have seemed. Darwin's book transformed what at first sight appeared to be an unreal fantasy into something that gave the impression of being real natural reality. But that reality turned out to be a completely different reality than people had known so far.[42]

4. Darwin's figures of speech clearly show that the rigid distinctions we make — in everyday life as well as in literary theory — between *literal* and *figurative*, natural reality and human culture, and *truth* and *fiction*, is untenable.

Only mankind speaks. Speech is *eo ipso* human speech. And thus too the world in which humans live is, of its very nature, a human world, a world 'de-picted' (a cultural world) — even in cases where we think we are dealing with a piece of unadulterated reality, untouched by human hand. Because we, humans, are creatures of speech, we cannot do otherwise than live in a world called into being by our verbal expression. In this sense the world in which we live is our own 'contrivance'. The fact that the figures of speech on which this 'creation' is founded are no longer experienced as such, explains why we usually fail to realize our share in 'worldmaking'.[43] With the choice of an *image* the scientist also selects an *experience* to which he or she gives extra relief; the experience chosen also means that a particular *practice* is highlighted; and in that practice a particular *reality* is born — for instance our world of production and consumption. Darwin's language threw a magic spell over the world, a magician's cloak, which showed the natural world in a completely different light. In so doing he contributed to the formation — a reformation — of the way in which nature would henceforth be 'seen', experienced and interpreted.

When figures of speech succeed, that is to say, when the innovative scientist's expressions are approved by others, author and readers will be united. The author's world will become their shared common world. Then people can, and must, communicate in that *world*, i.e. in that *discourse*. When we become aware of the original creative acts of expression founding our world, the acts by which this world came into

[42] This conclusion confirms the results of G. Lakoff and M. Johnson (1980, p.156).

[43] The term is Nelson Goodman's. For a succinct elucidation see N. Goodman (1984, pp.29-44).

being, we might be in a position to decide whether we want to continue retealing those acts of expression in our speech and comportment and thus to go on recreating the world that now is ours, or whether we want to explore other creative expressions which might establish other discourses and evoke other worlds.[44]

4.6 LITERARY GENRES

Darwin's *Origin of Species* is distinguished from other scientific works not only by its exceptional literary-rhetorical style and by the expansive and clear way in which it is written but also by the fact that it reminds us of various literary genres.

In the first instance it recalls the *myth*, in particular the myth of creation. The very subject it deals with makes this obvious. The rise of modern science meant that the ancient story of Genesis about the creation of the world had come to be seen as a scientific theory. A theory is an idea that can be tested against the facts. People wanted to compare the story of Genesis with the facts. Darwin himself speaks repeatedly of the *theory* of creation. But just as Darwin read the biblical story of creation as a verifiable scientific theory, so too, the reader of *The Origin of Species* can turn the tables on Darwin by reading his theory as a story or myth of creation. Things like the personifications of nature tend to make us almost forget that we are dealing with a scientific theory and believe that we are reading a mythical narrative.

According to Darwin's account animals and plants could have originated from one single prototype, and all living creatures could have a common origin. Plants as well as animals — yes, perhaps even human beings — could have developed from simple forms by means of intermediate forms.(447)

Darwin's account of the creation of nature very quickly replaced the traditional story of the separate acts of creation — henceforth it would be his story that would be told, certainly as far as science was concerned. And yet Darwin's story did not push God aside. In the closing sentence of his book he refers to *several powers*

> (...) having been originally breathed by the Creator into a few forms or into one.(450)

[44] cf. E. Jones (1989, p.117).

His account could be seen as complementary to the idea that in the beginning God created nature, in such a way that she could, as it were, develop further under her own steam (think of the Tree of Life which Darwin described so graphically). Darwin felt the need (and he was not the only one to do so at the time) to absolve God of all evil: indeed his account refuted the accusation that the Creator had made all kinds of creatures — dinosaurs and other species now extinct — only to allow them to disappear without a trace. Would not such behaviour on God's part be unjust? In order to absolve God of such shame it would be good to realize that the extinct animal species died from natural (secondary) causes:

> (...) to my mind it accords better with what we know of the laws impressed on matter by the Creator (...).(449)

As regards the living creatures themselves, it is more honourable for them to have been made by nature in the course of a long process than to have been created by God in one fell swoop. By their long line of ancestors and the enormous amount of work invested in them by nature, living creatures

> (...) seem to me to become ennobled.(449)

Indeed, there is nobility in labour.

One of the attraction's of Darwin's story of creation is that the development of life is still going on and that nature will continue to progress:

> (...) as natural selection works solely by and for the good of each being, all corporeal and mental endowments will tend to progress towards perfection.(450)

As well as being a myth of creation, *The Origin of Species* is something of a detective novel. The qualification given to the problem of the origin of species 'mystery of mysteries' — is an expression that would seem more at home in a detective story than in a scientific work.[45] There is a riddle to be solved: the complicated structure of living creatures and of nature as a whole. Whodunit? What's behind it? The riddle has to be solved on the basis of sparse evidence which is given body by conscious seeking and reasoning, combining and deducing. After a great deal of detective work the deed appears to have been

[45] In 1845 E.A. Poe published his *Mystery of Marie Roger*, one of the first examples of this genre in literature.

committed not by God, as was originally thought, but by nature in an act of auto-creation. The old creation story has become a *mystery story*.

Sometimes *The Origin of Species* reminds one of a *travelogue*. Darwin had been a discoverer himself and reported his travels in his *Journal*, published in 1839 by the same publisher who later on published *The Origin of Species*. The *Journal* was Darwin's first book and it proved a success, much to his delight:

> The success of my first literary child always tickles my vanity more than that of my other books.[46]

In 1856, a few years before *The Origin of Species* was published, David Livingstone returned from Africa as a famous discoverer. There is an unmistakable connection between his search for the source of the Nile and Darwin's search for the origin of species. Naturally enough, Darwin's account of his own intellectual voyage of discovery to the 'mystery of mysteries' was not something to interest readers most, at least not from a scientific point of view (for which he apologized in the introduction). Yet seen from the angle of narrative technique, the whole book rests on the epic, heroic, but oh so careful and conscientious first person singular. By telling something of his past experiences, Darwin let the book start with himself, and end in the same way, when he exclaimed about the grandeur of the new vista he had just opened up:

> A grand and almost untrodden field of inquiry will be opened (...).(448)

Occasionally *The Origin of Species* reminds us of a *fairy tale*, particularly towards the end of the book. Because Darwin has discovered the formula — almost a magic formula — of natural selection, plants and animals suddenly become comprehensible to us, humans, if a wand has been waved. Darwin's words have broken the old spell, as did the little boy's exclamation in the fairy-tale of the emperor's new clothes. Similarly, thanks to Darwin we no longer look at a living creature with the feeling that it is something beyond our comprehension.(447) He has finally enlightened us about living creatures: how they came to be what they are, how things are organized in nature's household. However, contrary to the story of the emperor's new clothes, no humiliation is involved: Darwin believed that nature was still fascinating and that reality was much more wonderful than anything we can imagine.

[46] A. Moorehead (1969, p.252).

Darwin attempted to open people's eyes, to make us see what nature wants us to see:

> Nature may be said to have taken pains to reveal her scheme of modification, by means of rudimentary organs, of embryological and homologous structures, but we are too blind to understand her meaning.(442)

Why have we been blind for so long? Why could we not read the signs provided by nature — rudimentary organs, embryological and homologous structures? Simply because we could not imagine how one species could give rise to another. It had all seemed too improbable, too incredible. Everything changed suddenly with the magic formula of natural selection discovered by Darwin — *the viewpoint I present in this book* as he wrote proudly. People thought that Darwin made the scales fall from their eyes so that they saw nature as she really was. The spell over nature was broken. But does *The Origin of Species* not cast another spell over nature?

Myth of creation, detective novel, travelogue, fairy-tale — as if all this is not enough, there is also a trace of the ancient *fable* in *The Origin of Species*. Fables were short stories proffering worldly wisdom and experience to its readers. The stories had to be short, to be promptly at hand for use in daily life. The following fable may serve as an example.

> A man who knew everything about the nomenclature of natural science, who could name every plant and every insect feeding on that plant, a man who could even supply several names for each creature, a man who spent his day picking up stones, chasing butterflies and increasing his catch with truly learned impassivity, such a man, a naturalist – they like to be called natural scientists – was walking through a forest and finally came to an ant hill. He began to dig around in it, examined the stores amassed by the ants, studied their eggs, some of which he placed under his microscope and, in brief, caused no little destruction to this industrious and careful little household. While this was going on, one of the ants dared address him. "Are you not, said he, one of the lazy people sent to us by Solomon so that they can see and learn from our way of life what it is to be industrious and hard-working"? What a stupid ant to take a naturalist for a lazy person![47]

It must be granted that *The Origin of Species* does not contain the kind of morality characteristic of the ancient fable. We do read in general terms ('theoretically speaking') how the animal and plant world runs, but that is a piece of scientific knowledge with no practical use.

[47] The fable is Th. Lessing's. Quoted by H. Weinrich (1973, p.67).

The information is not ethically relevant, you can learn no lessons of life fr the animals and plants described in *The Origin of Species*. Darwin does not moralize when describing nature (and how she functions), he simply relates interesting facts from nature — interesting, that is, to people who show a 'disinterested' love for the natural world. Any sign of a moral that had remained in 'nature stories' since the rise of scientific natural history — for instance, the realization that nature as God's creation offers a home to man and that nature is good — was eliminated by Darwin, much to the chagrin of his friend Sedgwick. Nature is harsh and strictly amoral. Notions of good and evil do not exist in the natural world. But someone like Sedgwick continued to hold to the belief that nature had a moral or metaphysical as well as a physical side to it. He believed that anyone denying the bond between moral and physical, (which according to him is especially apparent in biology, the *crown of the organic sciences*), was caught in *a deep whirlpool*. He wrote to Darwin after reading *The Origin of Species*:

> You have neglected this bond and, unless I fail to understand correctly, have done your utmost to break it at one or two fundamental points. If it were indeed possible (and thank God I do not think so) to break the bond, then in my opinion humanity would suffer a loss, would be dehumanized, and the human race would fall into a lower state of degradation than any we know from the written historical documents which relate our history.[48]

Darwin did indeed break the ancient bond between the physical and moral aspects of nature by denying that nature is good, and this is one of the major reasons why his book differs so much from the ancient fable form and makes his essay a work of science. Darwin recognized nature's beauty. But as a man of science he steadfastly refused to draw moral conclusions from of his view, to play the moralist or to don the mantle of the prophet. He especially avoided commenting on religious or social matters, even though he was often asked to do so. He did not consider himself an authority on these issues: morality belonged to the field of the clergy and the philosophers. In Darwin's view there is an enormous gap between man and nature as far as ethical questions are concerned. Morality can exist only for free, reasonable beings capable of making choices, and should not be projected onto the mechanical natural world, as was the case in the ancient fable.

[48] Ch. Darwin (1958c, letters, pp.228-229).

It was not Darwin himself but others, who used his doctrine to moralize. Social-Darwinians formulated a system of 'morality' borrowed from the cruel world of nature for application to the world of man: the cynical morality of the right of the fittest.[49]

And yet when we look more closely, we see that Darwin did in fact formulate a kind of morality, one of consolation and reconciliation: while it may be true to say that the natural world is cruel, yet nature works for the welfare of all living beings. I would like to quote in this regard the closing passage of *The Origin of Species*, an impressive final chord in which Darwin most clearly expressed this morality:

> As all the living forms of life are lineal descendants of those which lived long before the Cambrian epoch, we may feel certain that the ordinary succession by generation has never once been broken, and that no cataclysm has desolated the whole world. Hence we may look with some confidence to a secure future of great length. And as natural selection works solely by and for the good of each being, all corporeal and mental endowments will tend to progress towards perfection (...). Thus, from the war of nature, from famine and death, the most exalted object which we are capable of conceiving, namely, the production of the higher animals, directly follows. There is grandeur in this view of life, with its several powers having been originally breathed by the Creator into a few forms or into one; and that, whilst this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being evolved.(450)

The disappearance of the former belief in the goodness of nature, so superior to the world of man, *vide* the ironical comment in the fables quoted above, left a moral vacuum which Darwin and the Social-Darwinians filled, each in their own fashion. It is this moralistic aspect — though not necessarily moralistic in the sense of preaching — which gives *The Origin of Species* something of the ancient fable.

Darwin's fear of people reading his book as an illusion, a phantom, a figment of his imagination (see below) — in short, a 'story', something like a fable — is one reason why it is less unlikely than we may be inclined to think that *The Origin of Species* could, indeed, be read as a fable.

Apart from the beginning and the end, literary genres do not loom large in *The Origin of Species*. They can at most be read between the lines, as vestiges, traces, suggestions. Of course Darwin never intended to write a story — let alone a tale — about living nature. His calling

[49] See chapter three, § 2.

the origin of species a *mystery*, a word with so many connotations of secrecy, religious mystery, incomprehensible riddle and detective story, was not meant 'seriously'; it was, like the elements of the other narrative genres we have examined, meant to catch the readers' attention, to make them read on. Darwin was successful in this purpose — far better than he could ever have imagined.

By inviting his readers to share his feelings and observations, Darwin aroused a feeling of involvement among them: they allowed themselves to follow the trail laid by the author to bring them to the destination he had chosen. By making his readers participate in his wonder, amazement and shock, and by showing them how he finally learned to cope with those feelings, reading *The Origin of Species* became a personal experience. Led by Darwin's powers of imagination and fantasy the readers let themselves be carried away as willingly as the readers of a novel sharing the wonder, sharing the horror, sharing the amazement at what the writer told, and eventually reassured by the happy ending: the production of *the loftiest, the (...) higher animal species*.[50]

Darwin succeeded in getting his readers to imagine what they had never previously been able to imagine. He deliberately made them engage their fantasies. Below we shall see how Darwin stimulated the use of the imagination in his readers. But surely that is the function of a *novel* — to have readers imagine a world for themselves? Natural Selection labouring incessantly, Nature simultaneously laughing and cruel, animal and plant species gradually developing and taking on the most beautiful forms: these are characters from a novel, even though the action is extremely slow. Nature as drawn by Darwin is a kind of fairy-tale world — or, at any rate, a *storybook* world.

4.7 OF IMAGINATION AND REASON IN *THE ORIGIN OF SPECIES*

Seemingly unimportant details that had previously arrested no-one's attention set Darwin thinking. They gave him ideas that, though logical and comprehensible as such, filled him with wonder and amazement. In his book he evoked the same amazement in his readers, to whom such an idea as natural selection would never have occurred. Darwin possessed a remarkable talent for opening up unexpected new vistas. He knew that he had an eye for matters which easily escaped attention. What most people regard as trivial can be of the greatest importance,

[50] Darwin enjoyed reading novels!

especially when it is a question of trying to fathom how the natural world is functioning and how the *economy of nature* is organized.[51]

Take, for instance, the obvious fact that an animal is a living creature, dies after a certain time. This made Darwin, and Darwin only, wonder how long animals actually lived, and when and how they died. No contemporary manual of biology dealt with such questions. There was ample information about birth, reproduction, care of the young — but nothing about death and dying. And yet, as Darwin realized, this was an enormous problem. For the death of living creatures could not only be the result of age. Calculate, he wrote in 1854 to one of his correspondents, the number of descendants that a particular pair of animals could produce. Even assuming that half of the young survive to produce offspring, the number of descendants that one pair of animals could produce in its lifetime is enormous. In *The Origin of Species* Darwin gave the astonishing example of a pair of elephants.(76) The number of elephants issuing from one couple, provided they are not destroyed prematurely, is incredible: nineteen million elephants in 740 years descending from one couple!

Why is it that the fertility of elephants had such an effect on Darwin's imagination? Because in Victorian times questions regarding fertility and sexuality were affecting *everyone's* imagination. Birth control; the functioning of the sexual organs, a subject even being studied by a new science, sexology; the sexual relationship between partners in marriage; new views on marriage; such subjects were the focus of extensive study and discussion: in ordinary, everyday life, in social and medical science, but also on the larger scale of social and economic life and in art (literature and painting).[52]

Not just nature's fertility astounded Darwin, the reverse caused an equal sense of wonder: the enormous increase in numbers set off by large-scale annihilation. Darwin went from one source of amazement to the other, when he tried to imagine the circumstances surrounding unnatural death, when he tried to imagine how great the *destruction* of certain species was, annually or over the different periods of time.[53] How did those enormous numbers of plants and animals meet their end? Fertility was countered by brute force. The function of this physical destruction in the struggle for survival in the natural world was, as it were, performed by reason (in the form of birth control and

[51] Ch. Darwin (1985c, p.55 and letters, p.185).
[52] Ilse N. Bulhof (1983, pp.165-175).
[53] Ch. Darwin (1958c, letters, p.185).

technology) in the world of man. Malthus' doctrines stated that birth control would limit the number of children coming into the world, and an improvement in agricultural techniques would increase the supply of food. A balance would thus be established between the number of descendants and the food available. Where a peaceful solution was possible for man because of his use of reason, nature established the balance between the number of descendants and the food available by brutish destruction. Darwin found it difficult to visualize this. As he wrote:

> Nothing is easier than to admit in words the truth of the universal struggle for life we might say: in theory, or is more difficult – at least I have found it so – than constantly to bear this conclusion in mind.(74)

But without a full realization of this principle of destruction, full comprehension of nature's economy — including scarcity, abundance, extinction and variation — is impossible.

> We behold the face of nature bright with gladness, we often see superabundance of food (...).(74)

In other words, we see nature as all-giving, as cornucopia. But there are other things we fail to notice, which simply escape our attention or which we forget (suppress?), things in order which to notice we need to pay special attention, such as the atrocious destruction of life by the same 'all-giving' nature. For instance,

> (...) we do not see or we forget, that the birds which are idly singing round us mostly live on insects or seeds, and are thus constantly destroying life; or we forget how largely these songsters, or their eggs, or their nestlings, are destroyed by birds and beasts of prey.(74)

Malthus had already launched the calculating principle which Darwin used in *The Origin of Species* for elephants. Darwin developed the theme with a great deal of imagination and in his own special way, just as he did with the image of the Tree of Life and Lyell's geological record. Only a person with great empathy can imagine the cruel consequences of the immense destruction occurring in the natural world. Only a person with great imagination can conjure up images of the previously unimaginable.

With these images of the struggle for survival and natural selection Darwin destroyed an illusion: the illusion that nature is fundamentally good, like a mother who presses her children to her breast and, once they have been weaned, looks after them with love and affection. Nature appears to have two faces: the one laughing and joyful, the

other grim and cruel. We must not go by appearances (the smiling face we perceive): appearances are deceptive. We should reflect, and once we start thinking about her, nature appears to be far removed from what she seemed to be at first sight. The discovery was painful, also for Darwin. Nature destroys and crushes her weak specimens by allowing them to be overrun in the struggle for life.

Why should the world be like this? A question carefully ignored by science and therefore by Darwin. Science is only concerned with describing 'reality': the secret, grim, true reality, not the happy appearance, the beautiful illusion.

We do not really want to imagine large-scale destruction. Yet as researchers we should try to do so, however repugnant the prospect may be.

> Try in imagination to give any one species an advantage over another.(85)

And see where that leads. Here Darwin is asking his readers to imaginatively pursue a train of thought. He does the same when inviting them to look at a plant that has reached full maturity: why have its descendants not doubled or quadrupled? How can this be explained, while the number of descendants is actually very large, just as we saw with the elephant couple? The only possible answer is that large-scale destruction must have taken place. If we thus employ our imagination and critical faculties to gain insight into the interrelationship between all living things, we will soon realize how little we actually know of the subject. And so we must continue to imagine nature, and to observe and reflect (speculate) on our findings, however repugnant. In all this we should *keep steadily in mind*, Darwin repeats once more

> (...) that each organic being is striving to increase in a geometrical ratio; that each at some period of its life, during some season of the year, during each generation or at intervals, has to struggle for life and to suffer great destruction.(86)

By training our imagination in this way, we can learn to focus on the relevant data and pose the correct questions.[54]

Darwin even introduced imagination as a logical argument: the limits of what is conceivable by the imagination also point to the limits of what is possible; and *vice versa*, the unlimited imagination indicates unlimited nature, for instance in her capacity of continual self-

[54] See also E. Eng (1976) on Darwin and his images.

perfection. Darwin challenged the imaginative powers of his readers by asking why,

> If man can by patience select variations useful to him (...), why (...) should not the variations useful to nature's living products often arise, and be preserved or selected?(434)

What limits can be set to nature's capacity to produce a continual range of new varieties by natural selection?

> I can see no limit to this power, in slowly and beautifully adapting each form to the most complex relations of life.(434)

Because imagination cannot in all fairness imagine limits, it is unlikely that such a limit exists. On the grounds of this simple thought alone, Darwin believed and told his readers, the theory of natural selection

> (...) seems to be in the highest degree probable.(434)

The struggle for life is not an alluring idea. And yet we have to believe in it if we wish to know what nature is like, if we wish to know the truth about nature. In order to make the unimaginable imaginable Darwin reassures the reader.

> When we reflect on this struggle, we may console ourselves with the full belief, that the war of nature is not incessant, that no fear is felt, that death is generally prompt, and that the vigorous, the healthy, and the happy survive and multiply.(86)

This consideration calms the emotions aroused by the unimaginable and terrifying prospect and by doing so makes it acceptable.

In appealing to the imagination Darwin embraced the newer logic of discovery in which imaginative hypotheses played a major role.[55] Auguste Comte had been the first to break with the scientific paradigm which stated that science was a matter of observing what appears to us. Comte declared that in the 'positivistic era' of mankind's history, phenomena should be explained in terms of observations, hypotheses, and experiments to test hypotheses. His 'logic of discovery' found disciples including John Frederick Herschel, William Whewell, John Stuart Mill, and in France itself by Claude Bernard. (Yet Bernard and Louis Pasteur, for instance, were first and foremost experimentalists; hence they found Darwin too unrealistic and fantastic).

[55] See also chapter three, § 1. p.32.

By means of the imagination Darwin attempted to visualize or to imagine what the subject he was studying was like. Darwin's imagination worked with images — being the tools of the imagination. Translated into words (or verbalized), those images are the metaphors we find in the text: the metaphors Darwin created, his poetic use of language, can be considered as a direct result of the new logic of discovery.[56]

But at the same time Darwin was afraid of the power that the imagination could exercise over the mind of man, especially his own mind. For indeed, in the new approach to science imagination is no longer checked, for example, by religious considerations.[57] At the time the problems caused by the total freedom of the scientific imagination no longer controlled by any kind of belief originating outside the area of science itself had not yet made themselves felt.

When scientists in their pursuit of truth start to fantasize about what reality might be they do not keep strictly to so-called reality, for they do not know what that reality is. But if they cannot adhere to this reality in their thought process, there is a good chance that they may well drift away from reality, and start day-dreaming. Darwin's great fear 'of being certified insane'[58] is directly connected with the logic of discovery: it is the counterpart of his appeal to the imagination. He was frequently assailed by the fear that his imagination was running away with him.

> (cf:) Exactly fifteen months ago, when I first put pen to paper for this book, I did not have any good feelings about it and I thought that I had made a fool of myself, as so many others have done (...).[59]

The implied question in this passage conveys despair: am I mad or not? Darwin wondered if his imaginative reasoning would ever convince others. He was immensely relieved that Lyell, Huxley and Hooker, his three judges, put themselves behind his hypothesis, that they had actually allowed themselves to be convinced by his arguments.

[56] Positivism and Neo-Positivism obsured the importance of the imagination in science. But the imagination is making a remarkable come-back in contemporary reflections on science: see for ex. Th.S. Kuhn (1977, p.262), R.D. Romanyshyn (1982, 1989), J. Goodfield (1981), A.I. Miller (1984), L.J. Jordanova (1989).

[57] As was still the case with J. van der Hoeven, see chapter three, § 1.

[58] cf. chapter two, pp.23-24.

[59] Ch. Darwin (1958c, letters, p.227).

Darwin thought it *morally unthinkable* that scientists of their calibre *would be completely wrong.*[60]

His fear of being insane is also apparent in his letter to Gray, the American natural historian:

> Everyone, I suspect, occasionally thinks that he has worked in vain, and when one of these fits overtakes me, I will think of your article, and If that does not expell the evil spirit, I shall know that I am at the time a little bit insane, as we all are occasionally.[61]

According to Darwin, the powers of imagination were on the other hand often far too limited to imagine nature as she really was. It was inconceivable how something as wonderful as, for instance, an eye could have come into being in such an unspectacular way as he himself suggested: during an age-long accumulation of an infinite number of tiny variations or modifications. Indeed, a fairly trivial way of coming into existence. Whereas an act of creation, creation *ex nihilo*, out of nothingness is something of a completely different order. For creation is the act identified with God, or with the artist — at least, since the romantic movement (although the artist can only create in the mind and not in reality; the literary artist can create a literary world but not one that really exists; the sculptor can carve a statue of a human being but cannot create a live specimen). Such an act of creation — divine or artistic — is far more sublime than the slow process of evolution which nature uses, if Darwin is to be believed, to produce her creatures by natural selection. Nature, as we have already seen, was not an almighty intelligence, nor even an artist of genius but rather a dumb machine. How could one imagine such a machine to produce something as wonderful and complex as the human eye?

> Nothing at first can appear more difficult to believe than that the more complex organs and instincts have been perfected, not by means superior to, though analogous with, human reason, but by the accumulation of innumerable slight variations (...) this difficulty, though appearing to our imagination insuperably great (...).(426)

Such an idea is difficult to imagine not because it is *too difficult* but precisely because it is *too easy* to be grasped. It is substandard, below par.

[60] Ibid., p.225.
[61] Quoted by E. Eng (1976, p.64).

How can we help our imagination? Quite simply by engaging our powers of reason to follow the imagination:

> Reason tells me that if numerous graduations from a simple and imperfect eye to one complex and perfect can be shown to exist, each grade being useful to its possessor, as is certainly the case; if further, the eye ever varies and the variation be inherited, as is likewise the case; and if such variations should be useful to any animal under changing conditions of life, then the difficulty of believing that a perfect and complex eye could be formed by natural selection, though insuperable by our imagination, should not be considered as subversive of the theory.[62]

Apart from being too weak, too unimaginative, imagination can also prevent understanding a particular question or a correct conclusion, by refusing to take the path pointed out by reason. Why would imagination be unwilling to follow that path? Simply because it has a tendency to rise too high or to progress too quickly.

Imagination works with images. It conjures up images which we see before us in our minds. The products of imagination and dreams are off-the-peg images. If, for instance, we dream of a horse, the horse is there bang in front of us; we do not see the image developing. In other words, imagination works with sudden and surprising creations. In the same way God is creator of heaven and earth. He did not create the heavens and the earth in the course of a slow process. God spoke — and creatures appeared. He knew immediately what creation should be like. God is almighty, with Him thought and action are one: whatever he thinks, becomes reality straightaway. To paraphrase Darwin's idea: it is precisely because imagination does not work rationally or reasonably, but immediately conjures up the image of an idea or a thought, that it can be so dangerous for mankind. An immediate wonderful idea may be, of course, a marvellous conception, but it fails to convince. Indeed it is quite possible that the images shown to us by our imagination are not in accordance with 'reality'; that the 'dreams' produced by imagination fail to materialize. In such cases reason cannot and should not follow imagination. Thus Darwin's method suggests a *dialectic* of imagination and reality, a process of mutual correction.

As rational human beings we must be able to see the successive steps of an argumentation, otherwise all we have got is 'a nice thought'. Hence Darwin offered a helping hand to the imagination by elucidating

[62] Ibid., p.61.

such steps. He did so in the form of simple observations and expositions or propositions. He said, for instance, that any difficulty we may experience in imagining the origin of a complex organ like the eye through natural selection, disappears when we keep certain *propositions* in mind. These propositions imply that tiny individual differences can be seen in the build of animals and plants of the same species, and in their instincts; that there is a struggle for existence leading to the preservation of profitable deviations of structure or instinct — and, lastly, that gradations in the state of perfection of each organ may have existed, each gradation being right for the functions it fulfilled.(426)

These propositions bridge the gap facing the imagination when it has to visualize a species coming into existence through natural selection. Darwin maintained that the propositions were simple and crystal clear:

> They require no further proof and cannot be disputed.(426)

They serve as supports enabling imagination to proceed step by step. By indicating precisely what these steps were, Darwin was able to present his own position as acceptable to others. Thanks to these propositions the imagination can maintain its hold on reality. In literature imagination may soar aloft, to unreal, elevated, fantasized worlds. But not in science. Here imagination can and must soar, but only 'horizontally', so to speak, anticipating the actual course of scientific research, and constantly keeping in touch with it.

Imagination is connected with fantasy — a prolific fantasy produces a wealth of images. But what is it that excites our fantasy, that stimulates our imagination? We start to fantasize about something that intrigues us when we do not know exactly what it is like — and then we have to engage our imagination.

Could it be that Darwin was not satisfied with a mere romantic feeling of wonder in reaction to the natural world by which he was so enchanted? That he thought that nature not only required wonder and amazement for its beauty and the mystery of its origin, but deserved above all to be rationally understood? Did he consider it his duty to understand precisely what made nature so truly admirable, so fascinating?[63]

[63] Could Darwin's attitude also reflect a late echo of the early medieval – Anselmian and Augustinian – adage *fides querens intellectum* (faith seeking insight)? If so, his 'fierce' passion for understanding the mystery of nature would be an expression of love and respect rather than a sort of reductive thinking .

We are likely to assume that Darwin's efforts to understand nature at any price was based on an attempt to reduce all that is mysterious to a level where it can be comprehended by our small human intelligence. In the 1990s we almost automatically consider such efforts an attempt to trivialize the mysterious and the majestic. But it was never Darwin's intention to strip the majestic of its majesty. On the contrary, he never lost his love and wonder for nature — nor, indeed, his awareness of the mystery of it all. Nature was incredibly beautiful despite all her cruelty and ferocity, she was majestic and mysterious. And for that very reason, it would seem, she continually stimulated and tempted the scientist to invent new metaphors and undertake fresh research. She still does.

An illustration of the extent to which Darwin was aware of nature's majesty and mystery is, that he was practically unable to relinquish his belief in the Creator — even though such a belief was diametrically opposed to his rational way of thinking.[64]

In this respect we may be reminded, that in the Introduction to *The Origin of Species* Darwin was much stronger in his criticism of scientific colleagues who imagined that they were able to explain this beauty in terms of adaptation to circumstances (*preposterous*), than he was of believers (*erroneous*) who saw the hand of the Creator in the natural world.[65]

This was Darwin's belief when he wrote *The Origin of Species*, a belief that never quite disappeared, though becoming weaker. When, in later years, he tried to imagine a Creator, doubt crept in. Is the human mind to be trusted when it arrives at conclusions requiring so much imagination as the idea of a Prime Cause of all things? Is a Prime Cause not an unfounded fantasy, rather than an idea which can be proved to have a sound basis? Fearing that the human mind did not reach far enough he withdrew into a modest form of Socratic agnosticism. Indeed, the fantasy of 'God' could not be substantiated. But the majesty and mystery remained.[66]

Darwin's scientific work was sustained by this wonder and love for nature. At the same time he had confidence in the ability of reason to make the mystery comprehensible, to catch up with imagination. It is the tension between *the desire to admire* and *the desire to rationalize*

[64] In his autobiography Darwin describes the development of his religious feelings. Ch. Darwin (1958c, pp.59-69).

[65] See chapter two, pp.18-19.

[66] My interpretation of Darwin's position differs in this respect from that of J.H. van den Berg (1984).

which chases all wonder away, that makes his style so elusive. These conflicting desires help to explain why some people have been able to read *The Origin of Species* as a plea for the existence of an intelligent Prime Cause, while others have seen it as a reductive argumentation, indeed as the most successful attempt ever, to solve, clarify, and put aside the mystery of life once and for all.

The fact that he had been a great reader of poetry in his younger days indicates that Darwin had a feeling for language. This will certainly have contributed to the literary qualities of his style. In this respect it is disconcerting to recall that Darwin related in his later years how his aesthetic appreciation had diminished. Up to about the age of thirty he had been a keen reader of poetry of the most diverse kinds: John Milton, Asa Gray, Lord Georg Gordon Byron, William Wordsworth, Samuel Taylor Coleridge and P. Bysshe Shelley. He even enjoyed William Shakespeare at school, especially the history plays. He took intense pleasure in paintings and even more in music. He loved to walk and enjoy nature. But, as he wrote in 1887,

> (...) now for many years I cannot endure to read a line of poetry; I have tried lately to read Shakespeare, and found it so intolerably dull that it nauseated me. I have also almost lost my taste for pictures or music. Music generally sets me thinking too energetically on what I have been at work on, instead of giving me pleasure. I retain some taste for fine scenery, but it does not cause me the exquisite delight which it formerly did.[67]

And yet he had not lost all his taste for literature: he was addicted to novels:

> On the other hand, novels, which are works of the imagination, though not of a very high order, have been for years a wonderful relief and pleasure to me, and I often bless all novelists.[68]

Darwin compared his former sensitive (we could say romantic) mind with a non-sensing machine which fails to react to the material it is required to process:

> My mind seems to have become a kind of machine for grinding general laws out of large collections of facts.[69]

[67] Ibid., p.53.
[68] Ibid., p.54.
[69] Ibid., p.54.

He related the effect of his scientific work on his mind to the brain research being conducted at the time, and deplores his own coarse brain:

> (...) but why this should have caused the atrophy of that part of the brain alone, on which the higher tastes depend, I cannot conceive. A man with a mind more highly organised or better constituted than mine, would not, I suppose, have thus suffered.[70]

So far this chapter has analyzed the specific literary or poetic features of *The Origin of Species*: similes and metaphors, personifications, reminders of literary genres and the use of the imagination. The next section I will focus on what might be called the book's pragmatic or rhetorical features: the strategies used by the author to communicate with his readers in such a way as to directly persuade them to his point of view. The last section will provide a closer look at the logical argumentation and the role of experimentation in *The Origin of Species*.

4.8 Darwin's communication strategies in *The Origin of Species*

It is important to take the time to explain a new idea, to illustrate it with examples and, above all, to specify the stages leading up to it. Darwin had experienced this personally. He and Wallace had each read a paper to the Linnaean Society about the mutability of the species and its consequences, and yet the only result had been a short observation in the proceedings to the effect that what was new in their papers was incorrect, and whatever was correct, was old news. Moreover, as we have seen, the chairman stated in his annual report for 1859, that there was nothing to report that was in any way epoch-making.[71] This showed Darwin how necessary it was to explain a new idea *in extenso*, in order to attract attention.[72] As rational beings, Darwin believed, we refuse to accept anything new, any change in established knowledge, at face value. We want to follow the argumentation step by step. We want to know how a new idea has been arrived at. By closely following the stages of reasoning we, readers or listeners, are checking, as it were, whether the argumentation is consistent, whether it is reasonable or rational, whether it corresponds

[70] Ibid., p.54.
[71] See chapter two, pp.19-19.
[72] Ch. Darwin (1958c, p.24).

to reality. The same applies, said Darwin, to nature. In nature too we refuse to accept changes just like that.

> (...) the chief cause of our natural unwillingness to admit that one species has given birth to clear and distinct species, is that we are always slow in admitting great changes of which we do not see the steps.(443)

Darwin considered it insufficient to make, as many had done before, indiscriminate statements about the species having been modified in the course of time. Scientists must be able to demonstrate in detail how the process of change took place. Let me illustrate Darwin's train of thought with an example. The idea that a frog can be transformed into a prince is simply unacceptable to us. Such things do not happen in nature as we have come to know her in scientific research. Such stories belong to fairyland. But what about the idea of the wolf species turning into the dog species or, in other words, the idea that dogs developed from wolves? We will not accept this idea unquestioningly. We first want to understand exactly how this occurred. Which is why in *The Origin of Species* Darwin tries to explain step by step, and at great length, how nature developed — very slowly — to become the natural world that we now see around us. According to Darwin, Lyell had also found that people did not accept unsubstantiated new ideas like, for instance, the view that the world had come into existence very slowly. Lyell had not been satisfied with wild speculations, philosophizing or unfounded statements. He had shown in detail how our physical environment had come into existence in the course of millions of years, through forces that are still at work. So one cannot speak of a fairy tale world in Lyell's case. The genesis he writes about took its course in a manner quite unlike the way changes happen in a fairy story — very gradually, very rationally and regulated, and Lyell had provided a remarkably clear picture of that process.

The slow development from embryo to adult, Darwin believed, pointed in the direction of a gradual and detectable history of the origin of species. It had been discovered that the growth of an embryo constitutes a kind of 'record' — with the overtones of 'archive' — of the particular species, and that at the embryonic stage, species living today resemble ancient and extinct species of the same class(227), which might point to this type of slow development of the species. By contrast, anyone assuming that sudden changes have taken place in the development of the species, will be forced to admit that any such changes have left not a single trace. In other words, there is no proof nor even an indication of such sudden events. To Darwin, assuming such inexplicable phenomena or unproven events is equivalent to

quitting the *realm of science* and entering *the realm of miracles*(227). Darwin's rational and gradually unfolding argumentation has its parallel in gradually unfolding nature. Representation and represented correspond.

When readers are unable to see how a writer arrives at a particular conclusion, or how the change he is describing did actually take place, they become suspicious of being deceived. In that case the writer is running the risk of the reader shrugging his shoulders and ignoring the whole issue. Darwin concluded that in order to arouse interest in his subject, the writer must take the trouble of specifying every step in his argumentation. And that is exactly what he did in *The Origin of Species*.

Despite its being no more than a small part of what Darwin knew about the subject, the book still has a respectable length. Darwin's whole train of thought and the complete research process are extensively described, from beginning (his voyage on board the *Beagle*) to end (his conclusion). This makes the reasoning easy to follow, even for the non-scientist. His argumentation is, moreover, made even more accessible by a final recapitulating chapter.

Darwin took a great deal of care in organizing his material. He used to start a book by making a brief sketch, followed by a longer one in which he indicated in which sections he wanted to discuss the various topics. Good organization was the pre-condition of lucid argumentation. He had neatly recorded, organized and stored, in the form of notes, all the material he might use in publications. In this way he could easily recover information and details, if he was working on a particular subject. He had made a card index, which was very unusual for the time.

Darwin he also took a great deal of trouble to write clearly.[73] He regularly read his work out loud to his family, with whom his style was a constant subject of discussion and criticism. It cost him considerable effort to write readable English. He often had to laugh over his struggle with long sentences: if something could be turned into a bad sentence, he would write it. When he got himself hopelessly entangled writing a sentence, he would ask himself what he was actually trying to say; and once he had written that down, he could usually disentangle himself again. On one occasion a member of his family had encountered the same problem while writing a circular. On that occasion Darwin derived a great deal of pleasure from making improvements to the unclear sentence structure and other stylistic

[73] Ibid., p.105.

defects, thus taking revenge for the criticism he so frequently had to suffer from his family. After Hooker had read the manuscript of *The Origin of Species* and commented on its obscure language, Darwin sighed that he had laboured very hard, slaving away to write clearly; the fact that it had required so much effort on his part was indeed, he felt very strongly, a bad omen.[74]

Not only the use of extensive detail and good organization of material was of prime importance in communicating with his readers. The tone in which he addressed them in *The Origin of Species* was also a major factor: sincerity, enthusiasm for his subject, concern that the readers should not become bored, respect and sympathy for them.

Darwin was amazingly honest in the way he approached the explanation of his theory, listing not only the reasons in favour of it, but also all the counter-arguments he had been able to think of. It is as if he was inviting his readers to look over his shoulder every time he took a step forward and to decide for themselves what their standpoints for or against would be.[75] He had so many counter-arguments at his disposal because it was his custom to write down immediately any objection that occurred to him. He did so after having realized that he was far more ready to forget the objections than the ideas that supported his thesis.

Darwin's sincerity was also apparent in his persistent warnings to the reader that gaps exist in our knowledge (and thus in argumentation). He did this partly in the expectation that these gaps (the famous *missing links*) would come to light in the course of research:

> Many philosophers are not as yet willing to admit (...).(431)

For in point of fact, it is still a question of a theory (the *theory* my of descent with subsequent modification), and a great deal would have to be done before the theory could become proven fact.[76]

His sincerity is expressed most strongly in his pointing out to the reader phenomena that are not compatible with his theory, that indeed, contradict it. One of the strongest objections to his theory is, on his own admission, the fact that it is difficult to comprehend how the

[74] Ibid., p.212.

[75] See chapter two, pp.16-16.

[76] I. Hacking (1987, p.30) notes that it is common with innovators to feel hesitant about the status of their new insight: hypothetical or real. But in stating the matter in this rational manner Hacking obscures the emotional dimension of this hesitancy.

extremely developed organs, such as the eye. came into being in most trivial manner.[77]

In the first editions of *The Origin of Species* Darwin did not speak in the abstract of *extremely developed organs* in general but mentioned the eye *expressis verbis*. (The problem posed to him by the eye, as he acknowledged in 1860 in a letter to Gray, gave him *cold shudders* up to the day he wrote the book.) In a letter to Lyell he expressed his hope that the latter could confirm that he had honestly pointed out the objections to his theory.[78] For Lyell, Darwin's concessions to the opposition went too far: he had the feeling that by mentioning the specific example of the eye, Darwin gave too much rope to his opponents. The problem raised by the eye was indeed so serious and would require so many pages to be adequately refuted that Lyell advised Darwin to cut down on his honesty and to omit a few sentences from the text or to deal with the matter more thoroughly in a subsequent edition. But Darwin did not leave anything out and later merely substituted the expression *complicated organs* for the word *eye*.

In the letter to Lyell, Darwin added that it had taken him years to see certain difficulties *without embarrassment*. Was it perhaps a natural inclination on his part *not* to see certain difficulties — an inclination of which Darwin was ashamed — which caused him to be so sincere? Darwin's sincerity might, indeed, be partly attributed to his struggle against his own insincerity. It is painful to be so honest on matters which could be an obstacle to reaching one's goal — the more passionate the desire to achieve that goal, the greater the pain. Despite Darwin's self-assured demolition of the objections to his theory, the reader feels his dilemma, and this is exactly what makes Darwin so plausible and convincing a writer. This effect was unintentional, Darwin's sincerity was no rhetorical trick to convince the reader. But the result was no less effective.

By his mere enthusiasm Darwin sweeps us off our feet. He never tires of telling the reader about the incredible beauty and efficiency of living nature. Practically every page contains Darwin's plaudits for the way in which nature combines richness of forms, beauty of plants and animals with functional efficiency in organic creatures. To give but one example:

[77] I have discussed this in the section on imagination.
[78] Ch. Darwin (1958c, p.202).

> How have all those exquisite adaptations of one part of the organisation to another part, and to the conditions of life, and of one organic being to another being, been perfected? We see these beautiful co-adaptations most plainly in the woodpecker and the mistletoe; and only a little less plainly in the humblest parasite which clings to the hairs of a quadruped or feathers of a bird; in the structure of the beetle which dives through the water; in the plumed seed which is wafted by the gentlest breeze; in short, we see beautiful adaptations everywhere and in every part of the organic world.(73)

Laudatory adjectives are a common feature in Darwin's writing. When he read a passage to the family from *The Origin of Species* dealing with an insect with *beautiful paddles*, *wonderfully complex eyes*, *extraordinarily complex antennae*, it provoked considerable amusement. *We used to laugh at him for this sentence*, wrote his son, *which we compared to advertisement.*[79] This sort of romantic enthusiasm had already gone out of fashion in the era of positivistic science. Coolly observant scientific researchers had stopped presenting their findings with such spontaneity. Nowadays we find such an inspired style only in popular scientific writings or television programmes where the wonders of nature or of science are unveiled to the amazed reader or viewer. Darwin took it upon himself not only to write clearly but also to be entertaining, so that the reader would not be tempted to put the book down prematurely — not entirely unimaginable in view of its lengthy argumentation (the book was *one long argument*).(436) He had no desire to bore his readers with long and dull lists and explanations of definitions given in professional literature for certain terms, like *species*.(58) He had other good reasons to do so: experts cannot agree on definitions. But so what? Everybody knows more or less what is meant by words like *species*.(58) Descriptive and argumentative passages alternate. The descriptions are never dull: Darwin had an eye for picturesque detail. Take, for instance, his characterization of a type of pigeon, the pouter:

> A much elongated body, wings, and legs; (...) its enormously developed crop, which it glories in inflating, may well excite astonishment and even laughter.(41)

Sometimes he scattered anecdotes around — like the one concerning the barbarian inhabitants of Tierra del Fuego who, in times of hunger, prefer to eat their old women rather than their dogs.(52) What the breeder does with his animals — kill off the old ones and take care of

[79] Ibid., p.105.

the young and healthy in order to be able to breed from them — is the same as primitive peoples do with their old women: kill them. With this crude example Darwin placed old women and dogs on the same level in this primitive culture. He believed that the custom illustrated unconscious selection by primitive peoples. A curious phenomenon, to say the least, but a little far-fetched as an argument. Nonetheless it is this sort of detail that drives away boredom: we cannot put he book down.

Not only anecdotes but his frequently used comparisons also enliven Darwin's arguments. At one point he compared a breed of animal with a *dialect*: just as a dog has the wolf as its forefather, so cockney has standard English as its source. Darwin compared the old school of natural historians to savages: they looked at organic creatures *as a savage looks at a ship.*(447) Circumstances of life are not causal but merely provide the opportunity for changes in the species; they can be compared to a *spark* landing into inflammable material; the spark itself houses no flames, but it can start a fire. And one more example: how is it possible that in a population of millions of one particular animal species, all living in the same area and eating more or less the same food, such enormous deviations in body structure can appear in the course of time that their descendants no longer seem to belong to the same species? This must be because the same living conditions affect different individuals differently. In the same way *catching a cold* affects different people differently, one gets a head cold, another develops a cough, while still others contract rheumatism or infections.(32)

Darwin is well aware that his readers will not automatically go along with him. Had he not himself found it initially difficult to accept his own conclusions? So he can easily imagine that the same will apply to his readers:

> (...) when I first kept pigeons and watched the several kinds, (...) I felt fully as much difficulty in believing (...) as any naturalist could in coming to a similar conclusion in regard to the many species of finches, or other groups of birds, in nature.(46)

In other words, anyone who fails to agree with the author straightaway is not labelled stupid or obstinate. Incredulity is an obvious reaction, indeed, it would be a sign of an uncritical mind, if a reader familiar with bird life reacted otherwise. All the breeders he ever spoke to broke into laughter when he suggested that the different types they were breeding stemmed from one species:

> Ask, as I have asked, a celebrated raiser of Hereford cattle, whether his cattle might not have descended from Long-horns, or both from a common parent-stock, and he will laugh you to scorn.(47)

Fruit growers also showed only contempt for the suggestion that all the different types of apples and pears should be descended from one common seed. Breeders and fruit growers are people with expert knowledge — they have a great deal of practical experience behind them — and they swept away all the general arguments. But Darwin showed respect for them, even though they disagreed with him completely. Darwin was a member of numerous breeders' associations and he knew their members well. He often encountered them at meetings and obtained from them a great deal of the factual material used in his research.(49) He believed that they could teach nature lovers a thing or two, and also philosophers who are sometimes all too easily convinced by argumentation to change their minds:

> May not those naturalists who, knowing far less of the laws of inheritance than does the breeder, (...) – may they not learn a lesson of caution, when they deride the idea of species in a state of nature being lineal descendants of other species?(47)

Darwin does not give himself the airs of the omniscient expert, nor does he force his readers to accept his views at once. He does not preach, does not set himself above his readers, but converses politely and patiently with them as if they were equals, as is apparent from the following sentence:

> I have now briefly recapitulated the answers and explanations which, as far as I can see, may be given.(431)

He addresses those opponents who still hold to their belief in the theory of creation as:

> authors of the highest eminence.(449)

The way Darwin mentions some authors by name is equally pleasant:

> I may here allude to a remarkable memoir lately published by A. de Candolle (65)
> Professor Picket, in his excellent Review (305-306)
> Professor H.D. Roger's beautiful map (297)
> excellent naturalists as Agassiz and Picket (301)
> the most eminent palaeontologists (312)
> a highly capable judge, Dr Falconer (318)
> Agassiz and several other highly competent judges (332)

From the very first page of the book, indeed in the very first words, Darwin himself is present as a story-teller; he reports on his travel experiences, his experiments, his contacts with other biologists; he shows how he tackled the problems and the issues which are still not solved. He converses with the readers in the first person singular. He asks them questions, challenges them (*ask any animal breeder*), shares his experiences, utters exclamations. His directness is one of the book's great charms.

Close reading reveals how incredibly often the word 'I' appears in the text, not only in the introduction where he presents himself to the reader as a scientist, but throughout the whole book. In the chapter following the introduction, some twenty-six pages entitled *Variation under domestication*, the word 'I' appears no less than *seventy* times! He uses it particularly when reasoning and arguing:

> As far as I am able to judge, after long attending to the subjects (...).(31)
>
> I (do not) believe (...).(*passim*)

We often find 'I' in connection with his research:

> I have collected (...).(*passim*)

Or in relation to his own scientific labours:

> I have found (...).(*passim*)

Sometimes he uses 'I' in close relation to the text he is actually writing:

> I can add (...)
> Here I would refer to (...)

To which extent the use of 'I' enlivens the text may be seen in a sentence like:

> I have never met a pigeon, or poultry, or duck, or rabbit fancier(47)

The first person singular clearly arrests the reader's attention, but it also gives the text momentum: Darwin has *himself* done, seen, and pondered about what he writes. Whatever he discusses, first-hand knowledge and observation is involved:

> I have (...) discussed(46)
> I can state from my own observations(45)

At the same time the way he presents himself contains an element of modesty. The frequent interpolations like *I believe* and *I am of the opinion* tends to put his statements in perspective. He is only stating *his* opinion, and now it is up to the reader to judge:

> When we compare the host of agricultural, culinary, orchard, and flower-garden races of plants we must, I think (...)(48)

> A large amount of change, (...) explains, as I believe, (...).(52)

He is not always certain that what he is saying is correct:

> I am doubtfully inclined to believe (...)(40)

Darwin realized proudly that if his solution to the enigma of the origin of species were to be accepted, it would mean

> a considerable revolution in natural history(447)

He testified that his solution would also make the subject much more exciting:

> When we thus view each organic being, how far more interesting – I speak from experience – does the study of natural history become!(448)

The use of the first person singular makes one thing abundantly clear: this is *Darwin's* book, in more than one sense. It is only *his* opinion; but also: *his* work and therefore, if successfully accepted, *his* triumph.

4.9 LOGICAL ARGUMENTATION AND SYSTEMATIC EXPERIMEMTATION IN *THE ORIGIN OF SPECIES*

Perhaps the reader of this book is wondering where we should look for *logic* in *The Origin of Species*, and for the sober observation of facts established by *empirical research*. Surely they are essential for a work of science? We shall see that persuasive elements also slipped in when Darwin was attempting to apply pure logic in his argumentation, that is to say when he was not writing 'rhetorically' but was simply and solely putting forth arguments. Will-nilly he is persuading his readers by the very words he used — for instance by the impact of the scientific vocabulary used in contemporary biology, from the words borrowed from everyday speech and from the words coined by himself. A close

reading of the first paragraph of *The Origin of Species'* first chapter may provide an example of his argumentation and the effect of his choice of words on both reader and writer.

The chapter deals with artificially bred varieties of plants and animals, the first sentence reading:

> When we compare the individuals of the same variety or subvariety of our older cultivated plants and animals, one of the first points which strikes us is, that they generally differ more from each other than do the individuals of any one species or variety in a state of nature.(31)

Darwin wants to inform us that there are more varieties of artificially bred pigeons than of pigeons occurring in the wild.

This would appear to be a simple statement of observed fact. So many differences in the dogs we breed, so little variety in wolves living in the wild. According to Darwin this is one of the first differences we observe. But is it as simple as that? Darwin considered it so obvious that anyone would notice it. But that is of course by no means true; the thought had, for example, never crossed *my* mind. Darwin's statement *established* as a *fact* the great differences between animals bred in captivity and the tiny differences between animals in the wild; it *became* a fact because it had been stated as such. And after Darwin had said it, everyone reading *The Origin of Species* can of course make the same observation. It would appear that there is no earthly reason not to do so, since everyone can see it for himself. Surely what can be seen is true? 'If', he continues,

> (...) we reflect on the vast diversity of the plants and animals which have been cultivated, and which have varied during all ages under the most different climates and treatment, we are driven to conclude that this great variability is due to our domestic productions having been raised under conditions of life not so uniform as, and somewhat different from, those to which the parent species had been exposed under nature.(31)

We see something (great and small differences) and on that basis we arrive at a conclusion. What we can see must be true. What we can observe, constitutes a reliable starting-point for our argumentation. What we *see* in scientific research resembles the *axiom* in mathematics: a starting-point from which to proceed. The more reliable the starting-point, the more reliable the reasoning. A mistake in the starting-point leads to a totally erroneous conclusion. Darwin's starting-point was the enormous diversity among animals bred in captivity. The conclusion he drew from this 'fact' is that such variety is a consequence of the

different circumstances in which domestic and wild animals live (for everything has a reason or a cause).

Things are apparently different for wild animals and domestic animals. It should be noted at this point that Darwin had imperceptibly moved from *diversity* on to *variability* — quite a different matter. The word *variability* itself suggests a certain development, and fits into the framework of a gradual development of the subject of change, while the words *diversity* or *variety* simply indicate differences.

Darwin suggested that the *varieties* are *variations* on a single theme, on a single structure; that what makes the varieties of the single structure possible is *time* (as is apparent from the use of the phrase 'throughout all the centuries'): time is the continuous medium in which a particular structure can unfold, and unfold in various directions. With the use of the word *variations* Darwin does not mean differences existing at one and the same period of time but variations (or differences) developed in the course of time, in a succession of moments. Darwin gave the impression that he was unaware of the difference between these two words. And yet the whole evolutionary doctrine is accounted for when the words *variability* and *variety* are equated. For if the production of various sub-species from one species in captivity and also the mechanism by which this occurs can be demonstrated, it is no problem to demonstrate that the same sort of production also occurs in the wild: the model (how varieties develop) discovered in captivity can be easily recognized and pointed out in the wild.

Was Darwin naive? Did he not realize what he was doing by casually replacing *diversity* and *variety* with their static connotations by the more dynamic *variability*? Was he a cunning writer, sneaking in a new concept like *variability* so unobtrusively that no-one rebuked him for it? Or was he a slapdash writer, using words more or less at random? After all, we might add to his defence, Darwin was first of all a scientist, a researcher, and as such not accountable for every single word he wrote. Close attention to language is required only of a literary writer who is considered to write a text for the sake of the text, since the literary text is an end in itself. So, let's forgive Darwin for his inaccuracy. Surely the writing is merely a subordinate part of the work of a scientist? We should be glad that a man like Darwin has succeeded in so expressing himself that his readers, on the whole, understood the tenor of his writings very well.

We have seen, however, that Darwin spent a great deal of time and effort on his writings, and that he was truly sincere with his readers. Hence the most likely explanation is that he and other people at the

time were not really aware of the difference between *diversity*, *variety* and *variability*, because probably in everyday life they were used synonymously. Nevertheless, the *effect* of this synonymy was that the time element was slipped in and that the public — and Darwin too — came to see the time factor in this context as something quite obvious.

In the next sentence we find the word *variability* again:

> (...) this variability may be partly connected with excess of food.(31)

Darwin meant that animals bred in captivity were always provided with a surplus of food. In this sentence *variability* could just as easily mean *variety*. Or take this example:

> It seems clear that organic beings must be exposed during several generations to new conditions to cause any great amount of variation; and that, when the organisation has once begun to vary, it generally continues varying for many generations.(31)

Darwin again added the time factor: it takes a long time — many generations — before real variety is achieved.

It seems clear, he wrote. Darwin's reasoning is in a modest key, and not peremptory. He invited the readers to agree, while also inviting them to accompany the thought process which will lead them to the same conclusion: yes, it is clear that it has happened this way, it would indeed be difficult to imagine otherwise. For how on earth could a completely new species suddenly come into existence from parent to child, without intermittent changes? What was clear to Darwin also became clear to the readers by means of this sort of imperceptible interaction between readers and text.

Another interesting thing in this last passage is that Darwin did not write of *different* but of *new* circumstances. In the whole debate about the origin of species scientists tried to explain the appearance of *new* species, in other words: species which had not previously existed. The new circumstances and the new species of which Darwin wrote are not new in the sense in which a traveller in an other continent discovers 'new' species, species unknown to him at home: they are circumstances and species which were previously completely absent from the world, something new under the sun. The time element was thus once again built into the word *new* as used here.

What also seemed clear to Darwin (apart from the time factor) was that once the *organisation* had begun to change, the process was to continue for generations. However, this phenomenon as such would not seem to be absolutely clear at all. To start with, we would have to imagine that the process would only continue if those *circumstances*

were to continue; and even then, what is so obvious about it all? Is there a kind of power of continuous growth at work? And if so, what is it?[80]

Even more remarkable is that the words *organic creature* do not appear here, nor *plants and animals* as was the case at the beginning of the paragraph, but *organisation*. The words as used here, indicate that a plant or an animal, an organic creature in general, is apparently an *organisation*, a creature endowed with a particular regulated build (structure). According to this sentence it is this structure that will change once the process of change sets in. What characterized the new biology, replacing the old natural history, was the notion that organic creatures possessed an *organisation* or internal structure. In this passage Darwin pretended that having such a structure was the most normal thing in the world for organic creatures. Indeed, not only Darwin but also Donders, for instance, spoke of *organisation*. Evidently the word was in current use; hence Darwin did not feel the need to explain it. Here we are once again confronted by the same phenomenon as with the words *variety* and *variability*: the meaning of a word was taken for granted, and with it a new phenomenon was smuggled in. It was apparently assumed that an organism possessed a structure.

In *Les mots et les choses* (1966) Michel Foucault has pointed out how around 1800 the internal structure, the animal's 'inside' became of decisive importance for the classification of living creatures, replacing the external appearance, which had previously served the purposes of classification. To take one example: the internal structure of a whale in no way resembles that of a fish but that of a mammal. This is apparent when a whale is dissected and its inside is compared with that of other mammals. The same inside is seen when an anatomical study is made of the development of a whale embryo. In the same period it was discovered that an historic institution such as British Parliament was the outcome of a long historical process. Configurations which previously had seemed to have a random form appeared to be held together by some sort of internal necessity. What had previously seemed to stick together like grains of sand had since 1800 been shown for the structure it really was, thanks to an exposition of its genesis. Here again the discovery of the time factor was of crucial importance. Because of it, things in nature and culture, in biology and history were seen in another light: other aspects were

[80] See below, pp.122-123.

noticed, other factors were observed, other interpretations were given and other experiences were had.

It cannot, of course, be expected of Darwin to turn the reader's attention to such a general cultural process when he used a word like *organisation*. In his casual use of words such as *organic creature*, *organism* and *organisation* he showed himself an exponent and a promoter of his own cultural climate — just as in his use of similes and metaphors.

In the next sentence a *variable organism* is mentioned.(31) Are all organisms *variable* — that is, can they all change in time? The fundamental organisation of a crystal does not alter. But apparently that of a living organism does. Nonetheless the latter maintains its structure, its identity, we would say, throughout the changes, throughout time. In some instances the early stage has little in common with a later stage. In such cases it is only by following the process of growth step by step, that one step can be seen to emerge logically and continuously from the other, without illogical and unlikely gaps, that we are dealing with one and the same organism, a single unit structured in time. But Darwin does not comment on this point: he takes the phenomenon of identity through time for granted.

The question touched on above,[81] as to why an organism obviously continues to change once the first change has occurred, is explained by Darwin by the words:

> No case is on record of a variable organism ceasing to vary under cultivation.(31)

Here Darwin called on the experience of breeders and horticulturalists cultivating new species of animals and plants. In all previous publications on the subject, according to Darwin, and in oral communication with these people, no instance is quoted of a process of change suddenly grinding to a halt. That is the substance of his argument. No need to assume a vital or divine force or a mechanical means. Does the process of change continue indefinitely? Can it not be assumed that a poodle or a turkey represent an end product? Apparently not, for Darwin continues:

> Our oldest cultivated plants, such as wheat, still yield new varieties: our oldest domesticated animals are still capable of rapid improvement or modification.(31)

[81] See above, p.120.

New varieties: the word *new* used once more with the meaning *not previously existing*. Moreover, in this sentence *new* is now connected with *improved*; Darwin mentions improvement and change in the same breath — because they are identical? In this implied connection between change and improvement once again an important aspect of his doctrine of evolution is accounted for.

After reading this paragraph we are informed that variety exists (situated in the stream of time) and that once started, changes continue. These statements constitute the starting-point for the rest of the argumentation — not only in this chapter but in the whole book. But, we should ask ourselves, is this starting-point as formulated by Darwin a true *starting*-point? Not really, for apart from terms like *species* and *sub-species*, it presupposes a great deal of foreknowledge: that a living creature is an organisation; that variety is above all variety in time; that processes of change occur on a large scale in living creatures; and that such processes move in the direction of improvement. Darwin's point of departure is not the beginning of a line of reasoning developing from there, it may just as well be described as the final stage to which the whole account is leading. When looked at more closely it would appear that we are dealing with a circular argument: not due to illogical reasoning, but because of Darwin's *dependence on language*.

Something similar can be observed in what he considered his strongest argument: the similes upon which he based his analogies, especially the comparison between the consciously selective breeder and unconsciously selective nature. Simply by drawing these comparisons and making them acceptable Darwin gave, as it were, shape to the experience of his readers. He then asked in all innocence whether his readers saw what he saw, whether they concluded what he concluded! In this way Darwin himself created the premises or the facts which constituted the so called starting-point for his argumentation, and for his hypothesis which directed his research. Here again we are given the impression of Darwin arguing in a circle, through no real fault of his own.

In *The Origin of Species* Darwin expounded his opinion (hypothesis) for others to test. He put the question to his readers as to whether what convinced him, was also convincing to others. Where argumentation is concerned, *rhetorical* is usually contrasted with *logical*: rhetoric versus logic, rhetorical arguments versus logical arguments. This contrast suggests that where rhetoric is deployed, logic fails. Logic, of course, fails when conclusions are not logical, when the argumentation is not conclusive and the conclusion not 'logically' or

'as a matter of course' or 'necessarily' derived from what precedes. In other words, it fails when there is a gap between conjecture, hypothesis or image/imagination and true, definite (scientific) knowledge, a gap that according tot the speaker/writer needs to be bridged — and obscured. where logic fails rhetoric steps in.

But we already know that in the case of *The Origin of Species*, according to Darwin himself, there is no question of definite knowledge. Who better than Darwin knew that not all the facts, required to support the hypothesis, had yet been amassed.

> No one ought to feel surprise for our profound ignorance in regard to the mutual relations of the many beings which live around us.(30) (...) much remains obscure, and will long remain obscure.(30)

If Darwin writes as a rhetorician, it is not because he wanted to obscure anything. The incomplete material evidence means that there were indeed considerable lacunae in his argumentation; the argumentation was not watertight, and some spanners might be thrown into the works of his theory of evolution. But *where* exactly? It may well be that from the point of pure logic Darwin's argumentation has shortcomings and that he reasons in a vicious circle because of the words he uses. But the fact that Darwin was imprisoned in that circle is the result of the *ambiguity of the words and expressions* taken from ordinary language.[82]

Could Darwin not have prevented his circular reasoning by using another, more precise, more formalized type of language? This would seem a rhetorical question, for had he done so, the new knowledge he wanted to impart would have been neither comprehensible nor convincing. In his situation he *had* to resort to ordinary language — and because of his imaginative and communicative skills he knew how to make a virtue of necessity and to maximize its powers.[83]

Due to Darwin's literary skills the language of *The Origin of Species* is no longer the 'ordinary' matter-of-fact speech of daily life; it is most definitely *literary*. What then is the function of this type of language in a scientific work?

According to the anarchistic philosopher of science Feyerabend in *Against Method* (1975), what matters in science is not the truth, but

[82] In a hilarious essay O.K. Bouwsma (1985-1986) shows how the use of ordinary language words cannot be avoided, and that even the most rigorously scientific language remains tied to ordinary language. See also C.F. von Weizsäcker (1979).

[83] *The Origin of Species* confirms the discovery put forward by Ch. Perelman (1977) that the art of persuasion has many more aspects than logical argumentation only.

what works. Making rain by means of magical dances invoking rain, he says, is just as scientific as making it by cloud seeding from an aircraft. If the 'truth' no longer compels by force of evidence, we could say that room is created for 'compelling' means of another type: for 'irresistible' rhetorical argumentation. Feyerabend sees science as one great rhetorical trick.

With his anarchistic theories on science and the role of rhetoric in science Feyerabend is often regarded as the *enfant terrible* of the philosophy of science, making awkward remarks that are, however, often not taken seriously. But Finocchiaro too, in his study *Galileo and the Art of Reasoning* (1980), comes to the surprising conclusion that *both literary art and rhetorical persuasion have some role to play in science*: the role of breaking down resistance to a new theory which shocks people used to a different pattern of thought and experience, the role of placing them in a receptive mood and persuading them at least to listen to what the innovator has to say.[84] To Finocchiaro all forms of scientific communication are basically forms of the ancient art of persuasion: proofs ('demonstrations'), the description of tests and observations, the appeal to predecessors or experts, the rejection of other theories and the description of procedures followed, all have the function of persuading readers, and first of all, colleagues.[85]

Scientific texts are not just indifferent descriptions of how nature is, but poetic *visions* and personal *communications* addressed to persons — rhetorical communications. Hence the need to read and interpret such texts carefully in order to detect their manifest and latent meanings.[86] This is also realized by sociologists of science, who for quite different reasons have developed a feeling of mistrust with respect to science.[87]

Literary expression and rhetorical persuasion play a very important part in *The Origin of Species*. We might ask again at this point whether science is not in the first place a matter of research.

What is the role in *The Origin of Species* of elementary scientific practices such as observation and the systematic conduct of experiments? Darwin evinced a gigantic mass of facts in order to support his hypothesis — Huxley was right to be amazed at the way

[84] M.A. Finocchiaro (1980), p.66

[85] See also: Th.S. Kuhn (1977, p.292). We may add to this list of rhetorical devices the use of (foot)notes. cf. N. Gilbert (1977).

[86] See also note 1 in this chapter.

[87] For the rise of the sociology of knowledge see L.W. Nauta (1979). The sociology of science flowered at a later date.

Darwin was able to bombard his readers with them. The greater part of these facts were collected by others, especially plant and animal breeders who passed their information on to Darwin. In addition many facts taken from the relevant literature were used. He also performed a great many experiments himself on the breeding of new species, especially with pigeons. Darwin was able to convince his readers because he referred to such an overwhelming mass of factual material. The *facts* to which he points function as *argument* in his plea for the theory of the origin of species to be recognized as correct. They contribute in no small measure to his readers gaining the impression that his comparison between breeder and nature is valid, that his metaphor of natural selection works. The scientific researchers subsequently began to research in the direction indicated by the metaphor. They began to labour to 'materialize' the metaphor, that is to say: to make the metaphor concrete. But experiments and the facts they produce have also another important function: they limit the number of poetic visions and metaphors that may be materialized. The poetic function of scientists in making metaphors may seen unlimited — but in actual fact not all metaphors can be made to work — a topic dealt with in chapter six.

4.10 Searching language

Darwin's gift of lucidly explaining and expressing complicated matter played a considerable part in persuading his readers. His most effective aids were similes and metaphors, in other words: his evocative style of writing. The images do not only have the function of persuading others but above all of formulating his new ideas for himself. His expressive (poetic and rhetorical) language was the only way, I would conclude, in which he could give shape to his *groping efforts* towards a new conceptualization of the origin of the species. The literary *poetic* style of *The Origin of Species* is a *searching language*, fitting Darwin's exploring style of scientific research. The literary language of *The Origin of Species* is the kind of language required for the drafting of 'work in progress'. By making use of the logic of discovery, Darwin unwittingly introduced an element of imagination, a touch of fantasy — of *poetry* — into science. After the introduction of the logic of discovery, science can no longer be science in the sense of the Classical *episteme* and this is particularly clear in Darwin. Science has become endowed with something of the rhetorical and the poetical.

The groping, searching approach of the logic of discovery requires a language different from purely factual description, a language

enabling the researcher to *express* what he vaguely, intuitively 'sees': a *searching-poetic language*. It puts into words knowledge that is a product of *human* imagination — *poetic knowledge* (Gr.: *poeiein* = to make).

Searching procedures, the search aspect of scientific work are at present of great interest to philosophers of science. Apparently there is a grey area between the context of discovery and that of justification. In fact scientific research never seems to get beyond the research phase: the results are always 'provisional'.[88] Scientific research in our century is a search with a constantly receding horizon of the (as yet?) *terra incognita*, so that all knowledge remains hypothetical and 'fantastic'.

Darwin wrote *The Origin of Species* in its open, exploring and searching language long before positivistic scientific research was criticized; long before the role of discussion and argumentation in science was consciously perceived; long before it was recognized that facts cannot simply be observed but are always theory-ridden.

Written in such language, a book like *The Origin of Species* is not easily classified into the existing genres of informative, scientific, or literary texts. According to the standard conception of science *The Origin of Species* is no purely informative or scientific text: it is far too literary for that. Neither is it literature: its claim 'to be involved with reality' is too great.

With its open language — searching, poetic, rhetorical — *The Origin of Species* has something in common with all genres, Darwin crossed all existing borders. Just because the book was so much more attractive and comprehensible than the average scientific treatise the debate about the origin of species had a far wider reach than was ever dreamt of by Darwin. And since his readers did not expect any persuasive or creative type of language, they unwittingly 'fell' for it. Speaking from a literary point of view, the book was read uncritically, without interest in the language; and for that very reason one reader could get from it something quite different from another. Without realizing it, his readers were captivated by Darwin's images, by his language, and they began to see the world through his eyes. A vicious circle? I would prefer to say a *magic* circle; a circle constituted by the magic of language. *The Origin of Species* cast a spell on nature.

[88] See also Th. Nickles (1980, pp.18-49). "(...) we can view science in the large as a three-stage process (rather than the old two-stage process of discovery and justification), viz., generation, pursuit and acceptance, all three being stages of the discovery process". p.20.

In the genre called 'fiction' a creative literary writer is undeniably freer with regard to the existing world than a scientific researcher — even a 'literary' one like Darwin.[89] Perhaps we need to create a *new classification of texts*[90] based on the extent to which a text wants to link up with 'reality': that is, the prevailing *image* of reality of a particular time. Working out such a classification could lead to exciting studies. Would we need to reconsider the prevailing image of reality as existing outside of the text, exploring the *interaction* between scientific text and the reality it describes/evokes, and focusing on the shifting bounderies between 'nature' and 'culture'? I think so.

[89] A. van Soest (1980), M. Schipper (1979).
[90] See note 2 of this chapter.

CHAPTER FIVE

THE SEPARATION OF SCIENCE AND LITERATURE

5.1 HISTORICAL BACKGROUND

5.1.1 *Preliminary remarks: on the separation of science and literature*

In the preceding chapters I have argued that Darwin was both a great researcher and a great writer: that with his figures of speech he made us see the world in a different light. I have also pointed out that what are considered to be facts *became* facts because they had been stated as such and could consequently be observed and confirmed by everyone. For that reason I stated that 'reality' might not be as 'real' as we think.[1] An examination of metaphors like 'natural selection' or 'struggle for survival' has shown beyond doubt the close relationship in Darwin's writings between his *language* and the *world* in which he lived.[2] Why then have the language of scientific writings and the contents of these writings for so long been considered two completely different matters; why the belief in a reality that exists completely outside language; and what was its effect on nature — which nature did it 'produce'?

I would like to start this chapter with a sketch of the historical background of the separation of science and literature as we now know it. Claiming that knowledge of nature came from the systematic observation of nature herself, aided by scientific instruments, modern experimental science ousted the classical language arts, logic on the one hand and rhetoric and poetry on the other, from the process of truth-finding: science became 'doing research' on mute objects of the external world. Rhetoric became appealing to emotions where reason seemed to lack ground, and literature became 'playing with words' and creating 'fiction'. Subsequently the work of the literary theorist Ingarden will to illustrate how authors of scientific texts are supposed to avoid using any vestiges of rhetorical and literary style, and how readers of those texts are supposed to ignore them if they inadvertently

[1] See p.69, 89 of this study.

[2] See chapter four, § 5 of this study.

arise. Finally, I shall point out the moral and political function that belief in the separation of science and literature has, since the seventeenth century, fulfilled in our culture: it has put nature outside language and the world of human affairs in order to serve as a basis for truth. This function explains the concern and even moral indignation which is so often aroused when the separation is challenged.

In the study of the separation of science and literature over such a long historical period much work remains to be done. In the context of this study I can only point to some major issues.

5.1.2 *Antiquity and the Middle Ages; nominalism*

Actually, the story as to how science and literature became divided has to begin at the moment when Greek thinkers moved from mythical to philosophical thought, and from an oral culture to a culture in which the written word began to play an increasingly important role. At that time the search for philosophical truth (truth found by other means than stories, for instance, by reasoning) emerged, together with the fascination by the power of language on the part of the sophists whose rhetoric perturbed Socrates and Plato so much. Plato managed to substitute a universal truth not transmitted through language (the truth of the perceived Ideas, perceived without words) for the 'truth' advanced by his opponents, for whom what counted as truth could never take place outside language and human society.[3] The long argumentation that the new method of truth-finding in Platonic philosophy required greatly benefited from the fact that its successive steps were set down in writing.[4]

The exact logical language developed by Plato's pupil Aristotle for the universal science of Being, metaphysics, was conceived of as a tool without any meaning of its own, an unequivocal language directly conveying unequivocal truth, in fact, conveying Being itself. Logical language expressed rational (logical) and necessary Being. That Being was logical, and that logical language could express it were the basic premises of the Greek metaphysical tradition. They have plagued Western thought ever since. The contemplative knowledge of Being envisaged in the metaphysics of Plato and Aristotle was the forerunner

[3] H-G. Gadamer (1975, pp.383-391). It is doubtless possible to interpret the Sophists differently from the way Plato did and Plato differently from the way it was done in later Platonism, see e.g. E. Grassi (1970, pp.147-174). But in the philosophical tradition of metaphysics which has been common property since Antiquity, objective and scientific thought has always been opposed to imagination and poetic thinking.

[4] W.J. Ong (1987, p.26).

of the (experimentally verified) 'true' knowledge of modern experimental science: in both cases knowledge was seen as supra-personal, impersonal or objective; in both cases a separation was assumed to exist between the knowing subject and the known object — albeit that in classical metaphysics the separation was toned down by the assumption that the human mind and Being were intimately connected.

During the Middle Ages it was only gradually realized that such a conception of Being did not fit the context of the Christian faith. A truly free creator would create a contingent world that was not tied to the rules of logic. What would be the consequences of Christian theology for a language that wanted to speak truth? What was the relationship between language, truth and reality in the perspective of the medieval outlook? An answer with far-reaching consequences was given by the theological and philosophical school called nominalism founded in the late Middle Ages by William of Ockham (1300-1349).

Ockham stressed the gap between God as a free creator and his contingent creation.[5] He suggested a new ontology and a new conception of language. With his 'razor' Ockham removed from theology and philosophy Greek speculations on Being, especially the echoes of Platonic Ideas. God in his freedom may have created the world according to Ideas, but these were ideas He had made himself, ideas, moreover which human beings could not know. Nature, according to Ockham, consisted of particulars: particular things, bodies, events. These particulars contained no relational principles within themselves. Existing relations were imposed upon the particular existents by an external source, God. The consequence of nominalist ontology was that for the understanding of existing relations Aristotelian dialectical (logical) reasoning was useless, but observation and experimental methods were, on the contrary necessary. A contingent world ruled out the possibility that a priori reasoning would reveal reliable knowledge about it.

Nominalist ontology was complemented by a nominalist conception of language: language as convention. The words (names) we use — for example, the categories we devise — are of our own making, they refer to things, but do not express them. It was not denied that such linguistic conventions could articulate concepts arrived at by studying the world. Nevertheless, the relation between words and reality has remained problematic ever since. With this conventionalist conception

[5] On nominalism see M.H. Carré (1946), E. Moody (1958), J.R. Weinberg (1964) and H. Oberman (1967).

of language we are at the roots of eighteenth-century empiricism and of nineteenth- and twentieth-century instrumentalism and contemporary anti-realism. In the meantime, nominalism has lost its ties with the Christian outlook that gave birth to it. Because medieval nominalism discouraged speculation and stimulated observation, it contributed greatly to the growing interest in the ordinary things of nature during the Renaissance; a desire arose to be taught by the things themselves. In the seventeenth century the method of systematic experimentation was introduced; instruments began to play an ever increasing role.

By its allegiance to the ancient conception of an object of study that was kept in bounds by eternal laws of nature and therefore in essence unchanging, seventeenth-century natural science not only remained in the metaphysical tradition, but in a way even reinforced it. For in bypassing the commonality of being that was supposed to exist between Being and beings in Classical Antiquity and the Middle Ages, nominalism widened the gap between subject and object. This gap was at the root of the demise of the language arts, rhetoric and logic, from the study of nature.

5.1.3 *The demise of the language arts from the study of nature*

In the context of the sixteenth and seventeenth centuries the attention to things began to imply that one should not study nature by reading about her; in other words, it began to mean the rejection of knowledge acquired by reading texts. The effort which scientists made to be taught by nature herself constituted first of all an attack on the learned men at the universities who, schooled in the Aristotelian scholastic tradition of a priori logical deductive reasoning in their study of nature, devoted more attention to the difficult texts of Aristotle and company than to the affairs of 'simple' nature herself.[6] It also constituted an attack on the humanists and their art of finding truth by means of the rhetorical *ars inveniendi* or 'art of finding arguments' in discussing problems of knowledge. The demise of rhetoric represents an equally important stage in the 'emancipation' of science from language.[7]

Being educated in a culture dominated by the metaphysical tradition we are used to think of rhetoric as persuasion and ornamental speech. We suspect that in using it a speaker is trying to hide base motives. But from classical times till the end of the seventeenth century the art

[6] In a similar vein, Nicolas of Cusa (1401-1464) opposed the learned theologians who speculated about nature and advocated the simple approach to nature by laymen who looked at nature herself. H. Blumenberg (1981, pp.63).

[7] Poetry and rhetoric had become merged – a tendency which can be traced back to Classical Antiquity. cf. K.G. Hamilton (1962), R.A. Lanham (1976).

of rhetoric had been an efficient way of dealing with questions and problems,[8] a well developed investigative procedure, a manner of getting to know things in those areas in which the kind of certainty provided by logic, could not be hoped for.

Concerning human affairs deductive reasoning was impossible: one could never adduce and verbalize all premises. Human affairs formed therefore the province of rhetoric, not philosophy. One had to be content with probability. But probable reasoning is by no means arbitrary. In the absence of the rational premises of philosophy to base one's reasoning on (axioms), one could rely on testimonies of reliable witnesses ('authorities'). Ancient rhetoric, developed by Aristotle and *inter alii* adopted by Cicero, has its own type of argumentation: the argumentation based on probable premises as distinct from a demonstration, or *enthymem*. The *enthymem*, the making probable, is based upon relationships which are part of the topic under discussion. Aristotle had systematized these relationships in his *Topica*. Here general points of view (Gr. *topoi*, lat. *loci*) are presented from which a topic of discussion, for example peace, can be looked at from different angles. The *Topica* offers a method of finding practical truth, probable truth, truth that suffices the praxis of life. The major part of rhetoric consisted of the art of finding these points of view, *ars inveniendi*, or *inventio*, to use the latin words coined by Cicero. To search and find general points of view one had to turn to oral stories, oral and written histories, classical and biblical texts, proverbs, popular lore, etc. For this study of the relationship between science and literature it is important to realize that like logical truth-finding, rhetorical truth-finding presents an understanding of the world, or an understanding of truth, which takes place *in the medium of language*. Truth, and the world, were given in stories, in language — biblical story, stories of Classical Antiquity, stories and legends of saints and heroes. Nature, too, was part of this told world in which 'human' and 'natural' actors were not clearly marked as belonging to different ontological categories.

During the Renaissance and Baroque periods the rhetorical procedure of finding truth had become very influential, in matters pertaining to the human as well as the natural world: many areas of knowledge of natural things were discovered in which scholastic demonstration was of no use at all (this knowledge was told in histories, cf. Francis Bacon's *History of the Winds*). For that reason

[8] cf. P. Hess (1991), C.A. van Peursen (1989).

rhetoric constituted besides logic a second formidable opponent with which the new experimental approach to nature had to contend in establishing its new methods of truth-finding by experimental research.[9]

The victory of experimental science over rhetorical truth-finding was helped by developments in the art itself. Since Classical Antiquity, a significant change had occurred: the importance of primary rhetoric, the rhetoric of the spoken word, had declined. In the era of the printed word, rhetoric had increasingly begun to function as secondary rhetoric, the rhetoric in the written, usually printed text. A first consequence of this was that finding general points of view, *loci*, began to mean: finding specific places (*loci*) in readily available printed texts. The *loci* became more and more 'prefabricated' pieces of poetry and prose: clichés, stereotypes. A second consequence of the transition from primary to secondary rhetoric was that in writing about a given topic, an author had to apply the rules of rhetoric: not only the rules of how to try and find out about the topic under discussion, *investigatio*, but also the rules of how to put the investigation and its results into words, *elocutio*. Thus rhetorical truth-finding became more language-dependent than it had been when the linguistic medium had been mostly oral language or language committed to manuscripts.

The increase in knowledge, too, complicated the usefulness of rhetorical truth-finding. A contemporary edition of a *Topica*, covering not only the ancient knowledge but also the immense amount of new knowledge ('era of discovery'!) gained in the modern period, would have to contain everything concerning every topic worthy of interest: it would have to be a complete *summa* of the world. In a period in which knowledge increased so rapidly such a book was simply impossible to compile. The work of the Baroque *polyhistor* lost its relevance.

At the same time people became convinced that knowledge by observation represented direct knowledge of the objects perceived — think of Robert Boyle (1627-1691) and his air-pump, or of Galileo (1564-1642) and his telescope. In the modern period, seeing in the 'figurative' sense by reason and seeing in the 'literal' sense by the eye were both supposed to be forms of direct contact with the objects observed. Since Plato seeing seemed to bypass language: 'seeing is believing' as we say. Plato had stated that even a slave, provided he had a good mind, could find the truths of mathematics, Galileo remarked that even a child, provided it had good eyesight, could see

[9] C.A. van Peursen (1989) shows how in the philosophy of F. Bacon the verbal art of finding arguments was transformed into the art of doing natural science research.

what there was to see, for instance, stars brought closer by means of the telescope. Books seemed superfluous. The world seemed to free itself from language.[10]

Finally, Cartesian philosophy represented a particular heavy blow to rhetorical truth-finding. In his *On method* (1937) Descartes resolutely discarded probable knowledge as knowledge. Only certain knowledge qualified as knowledge. 'A half truth is no truth'.

All these developments together caused the conviction that truth-finding in natural science has nothing to do with language and that natural science is 'doing research': to experiment, to observe, to make inferences, to state hypotheses and verify them experimentally.

5.1.4 *Language in natural science: communication*

Yet the non-Aristotelian experimental approach to nature advocated, for example, by Bacon (1561-1619) needed language: if not to *find* truth, then at least to *record* it in order to *communicate* it to other scientists. What kind of language would be appropriate for the new type of truth-finding, now that the logical and the rhetorical ways had proved inadequate? Should scientific language still be appropriate to the object of study, as had been the case in the classical and medieval metaphysical science of Being? Questions such as these could not be avoided.

Some saw no problem. What was seen in nature should be reported to the world in uncomplicated language. According to Descartes this would require neither elegant writing nor humanistic training. As he wrote in *On Method*:

> He who thinks clearly and knows how to present his ideas in an orderly fashion, so that the reader clearly grasps what is meant, always succeeds in winning others for his opinions, even if his language is not cultivated and he has never heard about the rules of rhetoric.[11]

The passage indicates that Descartes sees the language of science merely as a vehicle for the communication of thoughts, and that communication was simply a matter of describing what one thinks, putting in words the ideas one sees in one's mind. Such a description was supposed to be essentially artless: rules of presentation were superfluous. When he came to speak on his work about metereology, a topic he had studied himself, Descartes proudly mentioned his way

[10] M. Foucault (1973).
[11] R. Descartes (1637, p.29).

of reasoning: how the arguments follow each other and cohere in such a magnificent way that the end proves the beginning, the beginning is proved by what is stated at the end about the consequences, without this being a vicious circle. Further details about the language or *style* in which this is attained are not provided. Descartes' rejection of communication as an art (or craft) parallels the rejection of rhetoric as a method of finding truth: presentation and finding of truth are separated from language.

Although Descartes, not an experimentalist himself, did not mention the problem of the appropriate language for the new approach to nature having to be somehow related to the object of study, this was done by others, for example, members of the Royal Society. The Society recommended for its members a language that would approach mathematical language as closely as possible ("urging them to bring all things as near to the Mathematical plainness as they can").[12] Although mathematical language may be the very opposite of literary language as we understand it, at least the question of language in science was not passed over at the time.

The writings of the chemist Boyle, an eminent member of the Society and remembered for the discovery of the law connecting the pressure and volume of gases ('Boyle's Law'), testify to his awareness of the importance of the right language for natural science. As is shown by Stevin Shapin and Simon Shaffer in *Leviathan and the Air-Pump: Thomas Hobbes, Robert Boyle, and the Experimental Life* (1985), the language, or 'literary technology', that Boyle devised — actually a new type of rhetoric, but not recognized as such — was meant to do justice to the communicative *and* ontological aspects involved in studying nature by means of experiments.

A major feature of his language is prolixity. Boyle reported his many experiments in great detail.[13] On the one hand, he wanted to facilitate the actual replication of the experiments by his readers, and, on the other, to assure them that he was not speculating in the scholastic way by performing experiments in thought only. The ultimate warrant for experimental knowledge was, indeed, the eye, and not the mind. In the new approach, Boyle realized, the production of true knowledge was dependent upon a collective witnessing effort: the (real) experiments had to be seen by witnesses and reported in such a way

[12] See chapter one, p.1 of this study.

[13] cf. for Boyle's new scientific language S. Shapin and S. Shaffer (1985), S. Shaffer (1980 and 1988). See also J.V. Golinski (1987).

that readers would believe that they were actually performed. By developing a verbose narrative style, illustrated by engravings and inkdrawings that provided detailed pictures of what he, as experimentalist, had done in the laboratory, Boyle shaped experimenters and readers into a community of actual and potential witnesses.

Next to verbosity, the use of long difficult sentences was part of his plan to convey circumstantial detail and to give the impression of verisimilitude.

> (...) I have knowingly and purposely transgressed the laws of oratory in one particular, namely, in sometimes making my periods[14] or parentheses overlong: for when I could not within the compass of a regular period comprise what I thought requisite to be delivered at once, I chose rather to neglect the precepts of rhetoricians, than the mention of those things, which I thought pertinent to my subject, and useful to you, my reader.[15]

By using these *literary* devices Boyle created a new non-literary category in the field of knowledge which he called 'matters of fact'. Matters of fact were 'certified' scientific facts, (written) pieces of non-personal knowledge or non-personal pieces of (written) knowledge describing what had been witnessed and observed by the eyes. Matters of fact had no ties with the speakers describing them. Their origin in a creative (poetic vision) of nature that was their original context was hidden. Creativity was assimilated to discovery. Therefore (matters of) facts put on the level with objects which do not change when moved *qua* time and space: they could be communicated by mail, and they could and should be obtained in similar experiments at other times and places. Non-personal certified scientific facts, stored in texts and in the minds of scientists, functioned as the secure foundation of subsequent experimental practice and discourse — much like Plato and Aristotle relied on the steps in reasoned argumentation that had been put down in writing.

Furthermore, Boyle reported experimental failure to impress upon his readers his authenticity. We have noticed the same strategy in Darwin.

As the form for his writings Boyle chose the essay — preferring the modest piecemeal reporting of experimental trials over the pretentious

[14] i.e. complete sentences.

[15] S. Shapin and S. Shaffer (1985, pp.63-64), quoted from R. Boyle's *Proemial Essay*.

gesture of developing grandiose systems as speculative philosophers used to do.

Modesty was also conveyed by his insistence that knowledge of physical causes — as opposed to matters of fact — was only 'probable':

> (...) in almost every one of the following essays I (...) speak so doubtingly, and use so often, *perhaps, it seems, it is not improbable*, and such other expressions, as argue a diffidence of the truth of the opinions I incline to, and that I should be so shy of laying down principles, and sometimes of so much as venturing at explications.[16]

Again we are reminded of Darwin.

When discussing matters of fact, however, Boyle felt that he could speak confidently: matters of fact were discovered, not invented; they can therefore 'make their own way', are 'very probable', and for that reason 'would meet with patrons and defenders'.

His overall style was dry and boring. In this respect Boyle followed the scholastics, preferring to write "rather in a philosophical than a rhetorical strain".

He avoided a practice much in vogue in the rhetorical style of reasoning and writing: the ornamental citing of authorities. Citations of other writers were to be used only as certificates to attest matters of fact. His sparing use of citations indicated that the author was not, in advance, committed to any theory before the carrying out of experiments.

An important — and in view of the recommendation of the Society, a striking — feature of Boyle's style is the conscious avoidance of mathematical language.[17] For one thing, the understanding of mathematics is limited to an elite. By not using a mathematical language Boyle hoped to reach a larger public of chemists, apothecaries, lapidaries, physicians, and, of course, other experimentalists. But he had yet another reason to reject a mathematical style: mathematical representations of reality pointed to an improper ontology.

Boyle was a nominalist. He considered the mechanical laws of nature as being imposed upon nature by God's will, and remaining forever subject to this will. Because the laws of nature lacked the quality of necessity that characterized a priori mathematical or metaphysical logical truths, human knowledge of the laws of nature

[16] From *Proemial Essay*, quoted by S. Shapin and S. Shaffer, p.67.

[17] S. Shapin (1988).

could only be contingent, and should therefore be stated in contingent (non-mathematical) language. The use of mathematical language would suggest necessity, in Boyle's opinion a theological mistake. Man-made mathematical idealizations, he pointed out, would substitute for the 'visible testimony of nature' the authority of men, human words and constructions: the sin of pride.

Boyle stuck to nominalism by making a distinction between the world of sensible phenomena on which he, as an experimental philosopher, worked and which he could come to know, and the invisible world behind them that he could not know. To him these worlds were similar, but not identical. Thanks to nominalism he could avoid the philosophers' *hubris* of pretending to know what that invisible world 'really' was. Scientific renderings of phenomenal reality, the accredited matters of fact, were merely the experimentalists' 'reflections' or 'representations' of the world's underlying structure. As statements *about* nature they serve the communication among scientists.

5.1.5 *Language in natural science: representation*

From the seventeenth century onwards, the 'direct' contact with nature by means of experimentation and observation was advanced as a replacement for verbal disputation with colleagues and acquisition of knowledge by reading books. How did the transfer of truth-finding from the medium of language (logic, rhetoric) to a supposedly direct intercourse with nature, and the 'representational' language communicating matters of fact in experimental praxis affect the object of study: nature? By rejecting rhetorical and literary language in truth-finding, and by relying on scientific instruments, experimental science *separated* nature from the realm of human affairs, and promoted the modern image of nature as being mute and anonymous. Scientific discourse *produced* that separation, *produced* a reality apart from man.

In the study of nature, nature's own testimony, Boyle affirmed, is more reliable than the testimony of human beings. In the experimental practice as instituted by him, legal and priestly models of authority as witnesses (witnessing the experiments being performed) stood central. But evidence from nature began to become more important than evidence from human beings. As matters of fact were considered 'true copies' of 'the constancy of nature' the student of nature seemed, by appealing to them, actually to be appealing to nature herself:

> (...) future appeals will be made to them amongst the learned, as to *the judicature of nature herself.*(my *italics*)[18]

As Boyle stated, people are often prejudiced and gullible:

> (the) pressure of the water in our recited experiment having manifest effects upon inanimate bodies, which are not capable of prepossession, or giving us partial informations, *will have much more weight* (my *italics*) with unprejudiced persons, than the suspicious, and sometimes disagreeing accounts of ignorant divers, whom prejudicate opinions may much sway, and whose very sensations, as those of other vulgar men, may be influenced by predispositions, and so many other circumstances, that they may easily give occasion to mistakes.[19]

The notion of nature giving witness had been around for a long time. In the Renaissance the study of nature in medicine, alchemy, astrology was felt to be a kind of 'reading' or 'diagnosing' natural phenomena.[20] From what could be produced and seen of nature (the 'effects of nature'), the student had to infer the hidden causes. The effects as signalling causes functioned as 'natural signs'. Natural signs displayed regularity, they testified to stable, law-like regularities. Thus the natural sign was discovered to be a new kind of evidence: *non-verbal evidence.* At first words, too, could function as natural signs. A true name was considered to be a sign in exactly the same way as a tine on a stag's antler signifies the antler's age, or smoke signifies fire. Therefore it was in this period important to find the correct names: words that were really 'telling', words that were really effects of causes. Nature's capacity to sign and signify came close to a capacity to speak, be it not in words. The evidence given by nature on herself was called 'internal', as opposed to 'external' evidence, the latter being what man said about her.[21]

Then, however, a differentiation began to be made between nature's signs and human words, between nature's signing and man's verbal speaking. Thus nature fell silent. She fell out of the realm of human affairs and became an 'externality'. The connection between human words and nature became conventional and arbitrary. At best words and things could parallel, correspond. Words, reserved for human beings only, could merely 'represent' or 'mirror' nature, or 'refer' to

[18] S. Shapin and S. Shaffer (1985, p.209).

[19] Ibid., note 5, p.218.

[20] I. Hacking (1978).

[21] I. Hacking, ibid., considers the discovery of the category of non-verbal evidence by Renaissance students of nature to be the decisive transition to modern natural science.

her. Words signified only what goes on in the speaker's mind, not what nature is like. There are no longer words *of* nature, only *about* nature. This latter development is clearly in keeping with nominalism.

Thus nature lost her capacity to witness. At the very moment that nature seemed to become the sole support for truth, she was severely lowered in experimental praxis. Nature was only so reliable due to the lack of verbal language: because she could not deceive (Boyle: "not capable of prepossessions, or giving us partial informations").[22]

What nature is, is ascertained by human beings with the help of man-made instruments and then articulated in human words — by those same men who investigated her. That is to say that in the experimental study of nature the (male!) scientists *represent* nature by *their* words; that *they* speak *in nature's place*.[23] To *represent* nature means to speak *about* her and to render her from a distance in a different medium by means of *verbal pictures* or 'representations'. Because the nominalist separation between human verbal language and nature had been accepted, the fact that the scientists speak *about* nature and not *for* her was not noticed. As nature did not speak herself, nobody could speak *for* her. She could not be 'represented' in the political sense of the word. Representation in the political sense of *speaking for* was legitimate only in dealing with people. For only people could speak, but could merely be prevented accidentally to do so in person, in which cases they needed a spokesman. Representation in the sense of making a faithful picture was appropriate in dealing with mute things, that is to say, in science.[24] In politics speakers (accidentally absent from the political forum) and spokesmen (present at the forum) are linked. In science mute nature and speaking researcher are separated. In politics, the wishes of the absent speakers are transported and translated (Lat.: transfero — to move from one place to another)[25]: conveyed to the political forum. In being moved (transported) from one place to another, human words can be 'translated' also in the senses of rendered in another language and interpreted. In science no

[22] In her description of the process in which nature 'died', C. Merchant does not mention the way in which nature lost her expressive qualities (C. Merchant, 1980), nor does E. Fox Keller in her studies of the masculine style of modern science (E. Fox Keller, 1985). Similarly, the 'languages of nature' in L.J. Jordanova (ed.) (1986) are languages made by humans.

[23] cf. E.Fox Keller (1985).

[24] On 'representation' in politics and in experimental science see S. Shapin and S. Shaffer (1985, chapter seven).

[25] In Dutch, the same word 'overbrengen' (Lat.: translatere, to move or transport from one place to another) is used also for the conveying (overbrengen) of greetings.

'translation' of nature's signs takes place: the representations are merely the scientists' constructions. If they are wrong, it is the scientists' fault, not nature's.

Nature was harmless and innocuous, because mute and kept at a safe distance. In Boyle's eyes she was, in fact, stupid. As he pointed out in his *Free Inquiry into the Vulgarly Received Notion of Nature* (1666), material nature obeying the laws of her Creator was devoid of purpose, volition and sentience, she was inanimate, "brute and stupid".[26] He referred to nature's "dead and stupid bodies".[27]

In the rationalist, more Plato-oriented tradition of the study of nature, nature did not fare any better than in the experimentalist tradition stimulated by nominalism. Nature was not so much 'stupid', as, in Galileo's words, 'unpoetic'. There was in this tradition another reason why nature could not be 'speaking', and required 'representation' in the non-political sense of making an exact verbal image: her mathematical and exact nature.

In contrast to Boyle, Galileo had no qualms in declaring that nature as a whole, as well as her components, are in essence a mathematical-logical structure.[28] 'The book of nature', he proclaimed, is written

> (...) in the language of mathematics, and its characters are triangles, circles, and other geometric figures (...).[29]

Specialized knowledge of mathematics was required to comprehend it. The book of nature as described by Galileo, however, did not resemble a verbal text. Reading a text involves reading in the sense of understanding meaning. It is *interpreting*: forming a well-founded assumption of what the words might in all probability be saying, while realizing that other meanings are also possible. A verbal text is much more *ambiguous* than geometrical figures. Galileo explained the difference between reading an (unequivocal) mathematical and an (ambiguous) verbal text with references to the Bible. In Scripture he found two languages, the one abstruse and figurative, the other plain and literal. Many biblical passages are written in obscure figurative language:

[26] S. Shapin and S. Shaffer (1985, p.202).
[27] Ibid., p.211.
[28] P.van der Hoeven (1966).
[29] G. Galileo (1957, p.238).

> I think (...) that it is very pious to say and prudent to affirm that the holy Bible can never speak untruth – whenever its true meaning is understood. But I believe nobody will deny that it is often very abstruse, and may say things which are quite different from what its bare words signify.[30]

Figurative biblical language is confusing, because it can be understood in more than one way: literally and figuratively. Especially to the common people such ambiguous language is confusing. In interpreting the Bible one cannot simply stick to its "unadorned grammatical meaning".

What is the reason behind this ambiguous language? Metaphorical passages, according to Galileo, concern matters that are hard to understand, matters pertaining to man's salvation, matters of faith. The sacred scribes could explain these mysteries only in figurative language, for only in that language could they 'accommodate' them to "the capacities of the common people, who are rude and unlearned". Only an elite, the wise and learned, understand the difficult but 'clear' (because unequivocal) logical language of philosophy and theology, and, according to Galileo, of nature. Biblical language, we might say, is deeply *rhetorical*: it takes the capacities of the audience into account, it has considerations for its public. The mathematical language of the book of nature, by contrast, is rude, artless, *non-rhetorical.*

Only when speaking about physical matters ('the earth, water, sun, or other created thing') biblical language is simple and unequivocal. In connection with the non-mysterious physical matters

> (...) the rule has been observed of avoiding confusion in the minds of the common people.[31]

In those cases, speaking 'but casually', 'the Bible has confined itself rigorously to the bare and restricted sense of its words', and speaks literally.

Thus non-mysterious nature 'speaks' in a much clearer way than the Bible: in the language of mathematics. That unequivocal language may be understandable only to an élite, but at least it is never confusing. In Galileo's view, nature herself would be unambiguous in her structure, a *literal* reality — a (non-written) *matter of fact*, one might say. The unequivocal, mathematically structured and 'necessary' natural world (necessary, as she is *in* fact and *as* a fact, existing in and for herself, saying only one plain thing) is most emphatically without

[30] Ibid., p.181.
[31] Ibid., p.182.

significance. Galileo's nature does not give signs. A circle is no sign. Nature, which *has* no language and *is* no language, is truth herself — unadorned, naked, literal truth. Whereas human speech is free to say what its speaker wants to say, to speak the truth or to lie, to say what is or fantasize, free to be earnest or playful, nature can say only one thing: the truth. Not only rhetoric is absent from nature, poetry is too. Nature is utterly *unpoetic*.

> Nature does not like poetry, fables and fantasies are to a certain extent essential for poetry, which cannot exist without them; but all sorts of untruth are so conflicting with the character of nature that poetry is as far removed from nature as dark is from light.[32]

While in the perspective of rationalism exemplified by Galileo nature figured as intrinsically constructed according to mathematical rules — clear, truthful and unambiguous — nature, in the perspective of Boyle's nominalism, is treated *as if* she were unambiguous. Because nature was supposed not to sign, signify or 'speak', the 'translating' or *interpretative role* of the scientists' language was ignored in *both* traditions.

Like Darwin's *Origin of Species*, the texts written by Boyle and Galileo are embodiments of their acts of *creative expression*, in which express their new vision of nature — a mute and inexorable nature isolated from specifically human concerns. At the time, this vision provided a defence against religious and political authority; in due the authors course it led to a defence by science against *all* authority — i.e. against all extra-scientific consideration for rationally directing research. This view of nature was also at the base of the split between the 'superior' exact ('real' or 'hard') sciences where researchers humbly submit to nature's truth, and the 'inferior' inexact ('pseudo' or 'soft') human sciences where truth cannot be verified by impersonal quantitative means, i.e. where human interests 'intrude'.[33]

Galileo's idealized mathematical-logical conception of nature and Boyle's empirical nominalist one have been hailed as powerful means to liberate nature from scholastic speculation and theology, and from the fantastic and anthropomorphic patterns of thought which blossomed profusely in occult Renaissance studies of nature. They have been applauded for helping men to liberate themselves from human (i.e. priestly and textual) authority. But, we may ask, was not another

[32] Ibid., p.238.
[33] cf. Ilse N. Bulhof (1980, pp.10-32).

authority installed: the so-called matters of fact serving as a new basis for a truth that could not be disputed? And was nature thus not again *surreptitiously* subjected to human authority: that of the scientists who now 'represented' nature's truth without translating or interpreting her? How emancipatory was the emancipation of nature from language *for 'nature'*?

5.1.6 *Experiments in natural science*

Fortifying the eye and its vision scientific instruments also contributed to the oblivion of the interpretative role of scientists studying nature and the subjugation of nature under the yoke made by science.

The material directness of the experimentalist's contact with nature by means of self-devised instruments was supposed to guarantee the truth of his (in)sight. But how direct is that contact, and how true that (in)sight? Why — in order to make nature visible — should contact by means of scientific instruments, such as Galileo's telescope or Boyle's air-pump, be more direct, and the (in)sight they yield more truthful, than contact by the unaided senses, which make nature visible through the medium of language? Are not *both* approaches to nature and their resulting (in)sights equally bound up with human perspective?

The experiments in which scientific instruments were used, were referred to in the seventeenth century as 'elaborate' experiments. The instruments, purposely designed as they were, produced *artificial* phenomena. 'Elaborate' experiments were contrasted with 'obvious experiments', which consisted of looking at 'natural' or 'common' phenomena,[34] features of nature not produced, or at most refined or cultivated by human agency. In 'obvious' experiments nature was not interfered with, or disturbed, let alone destroyed. 'Obvious' experiments dealt with the conditions under which life is given — refined by culture or not. 'Elaborate' research departs from the level of common human experience. It makes it possible to observe nature at a 'subhuman' or 'superhuman' level. In the experimental praxis a culture of a rhetorical-literary type was being replaced by a culture of a technico-scientific type. The change in perspective from 'obvious' to 'elaborate' experiments corresponded to the change in language from literary-rhetorical to mathematical. The use of scientific non-verbal instruments of truth-finding, not being connected with common human experience, intensified the silencing of nature brought about by nominalism. In the

[34] On the distinction between 'elaborate' and 'obvious' phenomena see S. Shapin and S. Shaffer (1985, pp.174-175). The distinction was used by Th. Hobbes in criticizing R. Boyle.

anonymous material that nature became in elaborate experiments, nothing but selfinterest could prevent human beings from making her subservient to their ends.

The founding idea of the modern world was the nominalist intuition that human-made words cannot *grasp* or capture nature as the contingent product of a free God. Human-made words cannot *express* nature and nature is *not expressive*.[35] Mathematically structured nature is unrhetorical, and univocal or unpoetic. Given these premises, the new experimental natural science *could* not consider verbal language a source of truth, and even less a medium in which reality could be unveiled (a 'house of Being', to quote Heidegger). After the separation of language and nature and the devaluation of language to arbitrary signs and a 'mere' human phenomenon, language was only useful for plain transfer, not the finding or the articulating of truth in science. Language and reality, humans and nature, had nothing to do with each other.

5.1.7 *From the eighteenth to the twentieth century*

The eighteenth century was in many ways an age of transition. In scientific writings much attention was still paid to form and style.[36] The French natural historian Georges-Louis-Marie, count de Buffon, for example, was valued for his elegant style of presentation. Stories passing on experience and information collected by earlier generations of scientists still figured in scientific tests. But nineteenth-century positivism finalized the separation between science and literature in the study of nature. In our century neo-positivists like Robert Carnap and Carl Gustav Hempel have done much to impress the standard image of science upon us, one of its hallmarks being exact and logical language. In contemporary scientific writing precision, brevity and logical reasoning support the impression that science is logically consistent and values the natural and objective; these devices are supposed to prevent ambiguity by making the meanings of words, terms and sentences unequivocal and logical.[37]

The prestige of science is high, much higher than that of literature. The anti-literary bias in our modern way of thinking is strong. The

[35] On the lasting influence of nominalism in philosophy of science see also I. Hacking (1978), in particular pp.108-111, and N. Rescher (1987, p.xii).

[36] W. Lepenies (1976).

[37] H. Koningsveld (1976, p.44-56). See on the standard image of science, Ibid., p.58-90. See on logical positivism K. Bayertz (1980, pp.11-51).

separation and hierarchical ordering of the more elemental 'lower' world of a mute nature ruled by laws and the more ephemeral 'higher' world of free and speaking human beings have become commonplaces in our culture. But the 'higher' more often than not is (literally?) the 'lower': the domain of culture, the domain of the creative human mind, is seen as superimposed upon the more important, because more basic, realm of nature. Values which are 'free' are added to facts which are 'fundamental' and not to be tinkered with. In the marxist tradition culture and values were seen as the merely ideological (non-real) superstructure resting upon the (real) material substructure of reality. Whether the creativity of mind or the solidity of the material world is given primary importance in theory: in fact facts are basic. They are the rock upon which modern culture is built. As Shapin and Shaffer put it aptly:

> (...) in the conventions of the intellectual world we now inhabit, there is no item of knowledge so solid as a matter of fact. We may revise our ways of making sense of matters of fact, and we may adjust their place in our overall maps of knowledge. Our theories, hypotheses, and our metaphysical systems may be jettisoned, but matters of fact stand undeniable and permanent.[38]

As my focus in this study is upon the language of scientific writings, I will be very brief on the fate of literary writings. During the eighteenth century, literary writings began to look more and more 'literary' when placed side by side with the texts of natural science. The Romantic movement in art and literature stressed the difference between creative literature and non-creative science: Romantic poets rejoiced in their freedom, imagination and originality. They freed themselves from still existing remnants of rhetorical rule-bound writing. Rhetorical concerns disappeared from literature. Moreover, poets wanted to do more than 'represent' or copy the world[39]: they strove to be original, and expressed highly personal feelings, for example, about nature. They did not care to indicate what the connection of their writings (now Literature, with a capital L) with 'reality' as studied in science might be.

Since the Romantic movement there have been literary authors who wanted to be scientific by describing exactly the world of man. The social sciences and history often represented a kind of link between

[38] S. Shapin and S. Shaffer (1985, p.33).
[39] U.D. Boyd (1968).

literature and science.[40] Nietzsche on the other hand attempted to transform science into art: classical scholar with a great interest in the ancient art of rhetoric as he was, he mocked the illusion that natural science could emancipate itself from human concerns, from language in the first place. But he was a loner. For all practical purposes the separation of literature and science became generally accepted and firmly institutionalized in educational systems, university departments and government ministries. In this respect the metaphysical tradition has tightened its grip.

By this excursion into the past I intended to show two things: that the separation of scientific and literary language in the modern period is the counterpart of the separation of a supposedly mute and unfree world of nature and a supposedly creative and open world of human beings, and that this separation is far from self-evident. Nor has it ever become completely realized. As we will see, scientific writings have never been completely purged from literary elements.

5.2 Ignoring the actual text of scientific writings

5.2.1 *Science after Darwin*

In *The Origin of Species* Darwin attempted to express what he saw before his very eyes: natural selection. This sort of poetic image gave birth to different kinds of associations in the minds of different people and thus to widely diverging interpretations. Yet most of the readers did not consider *The Origin of Species* an unclear, let alone a poetic book, whose significance and meaning needed to be determined after careful reading. On the contrary: the readers were quick to form a very decisive meaning as to the contents and in doing so were quick to forget that in fact they were dealing with the meaning of a *text*. Depending on their personal disposition they were either angry about the book or regarded it as wonderful, but whatever their reactions, they did not rack their brains to what the *text* actually meant. Does this mean that they were all sloppy readers, with no feeling for language? I would like to suggest the opposite: nineteenth-century readers had learned that the correct attitude to read a scientific book was to ignore the language. Perhaps the readers in question were well able to read literary works with a feeling for language, but when reading a (scientific) work like *The Origin of Species* they obediently suppressed

[40] W. Lepenies (1988).

the impressions received by their literary antennae. We still do, if we read scientific works at all — which for non-scientists is not very likely.

Science has changed a great deal since the time of Darwin. For one thing, science has become professionalised. It offers careers to numerous people, it has its own social circuits, it is big business, the state has a vested interest in it, it has become intertwined with technology. Nowadays natural science opens up seemingly unlimited possibilities for technical intervention in nature on the subhuman, the human and the super-human level. It investigates nature as the substructure of human life, the ground on which, and the background against which, human life is being lived. Moreover, because of its specialized nature, the contemporary study of nature no longer addresses itself to non-scientists such as theologians, philosophers, literary authors and scientists working in other fields (although some of these outsiders continue to take an interest in it). A science studying its objects of study as completely separated from human beings can no longer contribute to people's orientation in life. Non-scientists today have far fewer reasons to read natural science texts than during the eighteenth, and the first half of the nineteenth century.[41]

5.2.2 *Roman Ingarden on scientific writings*

The work of the literary historian Ingarden (1893-1970) provides a good example of the standard opinion that there is a gap between, on the one hand, literature and the world of human experience and, on the other hand, natural science and the objectively existing world of nature. For two reasons I would like to go into Ingarden's position in greater detail. To begin with, Ingarden himself aptly points out that, in spite of all efforts to the contrary, literary language remains present in science. And, secondly, an analysis of Ingarden's position will show that the separation between science and literature is maintained by the fear of losing the sense of reality, i.e. realizing the fictitious 'imagined' character of reality.

In the context of his studies on literary art in *Das literarische Kunstwerk* (1930) Ingarden made some remarks about scientific writings, which he expanded in his well-known book *Vom Erkennen des literarischen Kunstwerks* (1968).

Ingarden observes a difference between literary and scientific writing (just examine a novel and a scientific treatise, and the difference is

[41] G. Marcus (1987, pp.27-29). In popularized versions, in which scientifics theories are translated to laymen, it can still attract readers.

clear, he suggests), a difference he explains on the grounds of the difference in aim. A literary work of art aims at arousing an aesthetic experience in the reader; the scientific text wants to point the way to a reality outside the text itself. Ingarden stresses the contrast between literary and scientific writing for several reasons.

As he sees it, the literary text, a work of art, is an end in itself. Everything centres on the act of reading, the experience of reading and the pleasure of reading; one reads for the sake of reading. The scientific text, on the other hand, is a means to an end: that of obtaining scientific and systematic knowledge of a world situated outside the text.[42] Scientific writing fulfils the function of being an indispensable support to the advancement of science: it establishes the state of research at a given moment, so that the succeeding generation of researchers can build on it. Thanks to the existence of such a text, the great building of science grows (a metaphor previously used by Descartes).

> Without the existence of the corpus of scientific literature the advancement of science and of human culture would not only be slowed down but it would even become impossible to maintain the level of advancement achieved.(151)

To safeguard that progress Ingarden wants his research to contribute to the clear demarcation between literary and scientific writings.[43]

A second reason for Ingarden's emphasis on the contrast between literature and science is his rejection of subjective interpretations of literary texts. Ingarden was passionately set against literary opinions suggesting that in the act of reading, the reader would encounter only his own reflections — as if a literary text were no more than a prelude to the awakening of certain feelings in the reader; as if the important factor in reading was the reader rather than the text.[44]

When reading a literary text readers mentally 'actualize' or concretize various meanings. Ingarden emphasizes in his theory of literature that the diversity of meanings does not spring from the

[42] R. Ingarden (1968, p.153). In this section the numbers in the text refer to this book.

[43] The notion that scientific research can be pursued and developed further thanks to the existence of the scientific text (R. Ingarden Ibid., p.151) can also be found in E. Husserl's *Vom Ursprung der Geometrie* (first published in a Romanian journal in 1936, reprinted in the *Revue Internationale de Philosophie* and appearing in the Husserliana (1954, vol.IV). Ingarden belonged to Husserl's phenomenological school.

[44] In his way he adapted Husserl's famous motto "back to things" to the objects of literary science.

reader's own subjective insight but is mostly the result of a conscious stylistic act on the part of the author. The richer a literary text is in meanings, the more satisfying its aesthetic effect. Thus, while it is true to say that reading a literary text is a 'subjective' act, in the sense that it is an individual act, the many meanings which are revealed to the careful readers have their origin in the text itself. Since they have been consciously placed in the aesthetic object by the writer, they belong to the text: in other words, they are objective.[45]

A scientific text, on the other hand, does not possess such richness of meanings. The meaning of a scientific text is (and must be) unambiguous: if it were ambiguous it would no longer be able to fulfil its function as support to the advancement of science. Only when the work in question is expressed in unambiguous and crystal-clear language, can all its readers comprehend it in exactly the same way; then they can take the next step forward in research, a step following logically from the preceding one.(160) Exact language is required in science, in order to guarantee the possibility of several scientific researchers taking the same or complementary steps forward; unclear use of language would leave such possibility to mere chance. From this point of view the excess of interpretations, as provoked by *The Origin of Species*, must imply that Darwin's book is not a good scientific text.

An unspoken third motive, hovering in the background, may have influenced Ingarden to stress the boundaries between literature and science: resistance to the ideologizing of science.[46]

Most important of all, behind his concern about the advancement of science and everything related to it, there would seem to be deep, hidden fear: fear of a *loss of the sense of reality* — a 'remarkable effect', which can be caused by ambiguous language in scientific texts.(165) Lack of clarity in a scientific text or such obscurity that prevents the reader from according any meaning to the text at all, results in the text failing to refer to reality: the reader is prevented from achieving contact with the 'autonomous sphere of Being', the reality transcending the text. Reality appears to remove itself, to be no longer capable of being grasped. The carpet is pulled from under the reader's feet. An

[45] In this regard too Ingarden shows himself again to be a disciple of Husserl: like him, Ingarden wished to protect the objects that man studies, in this case literary work, against subjectivistic notions of knowledge.

[46] K. Mannheim's essays on that subject date from 1929 and 1931; they are part of his *Ideologie und Utopie* published in 1936. In the period in question there arose in Russia a kind of 'soviet science' (the party knows best), which felt itself superior to the objective and so-called bourgeois science of the West. For the problem of science and ideology in this context see L.W. Nauta (1979, pp.4-13).

experience guaranteed to cause anxiety, Ingarden must have thought, where questions arise such as: Where am I? What is reality and what is illusion? But Ingarden wards off the imminent crisis: there are always sufficient possibilities left for the reader to hold out, to 'escape from the insecurity and ambiguity thus created'. For indeed a scientific work usually generates sufficient vibrations to enable the reader to make contact with reality, since, as he puts it, reality is what a scientific work is all about. The existential dizziness is only temporary.

We could say that an important *effect* of the simple, unadorned, often mathematical and exact language of scientific writings — a language of statement, of assessment, of truth — is to guarantee that (a sense of) contact is established with a reality situated outside the text. In other words, the unequivocal literal language of the scientific work *creates* the illusion that we are in contact with 'literal' reality 'itself'. The unequivocal scientific style, devoid as much as possible of literary 'frills', provides support for our longing for the reassuring presence of a reality independent of man. By requiring writer and reader to avoid the literary and thus the emotional, the distracting, the amusing, the entertaining, the ambiguous, the irrelevant and the confusing, or if that were impossible, to overlook it as really irrelevant, it is *impressed* upon us that a world exists, independent of speech, of writing, of research (that is, independent of us as perceiving and thinking human beings).

The fascinating aspect about Ingarden's stance is that, language-conscious as he was, he realizes at the same time the importance of language in scientific texts so well. He makes it clear that scientific language should comply with strict requirements, yet he is also of the opinion that it must be invisible. But, we may ask, how can something so invisible be really important? Could Ingarden himself have fallen victim to the game which the exact language of modern science plays with the reader? Did the game force him to do exactly what was expected of him: to ignore the actual text?

Ingarden provides writers and readers with outstanding guidelines to do so. Using a comparison between literary and scientific texts, he points to the elements of which the writers and readers of scientific texts should beware in order to avoid yielding unawares to the power of language. His first warning, to avoid ambiguity in scientific texts, has already been mentioned. Other guidelines refer e.g. to visual representation and truth.

Literary works are characterized not only by ambiguity but also by visual or graphic representation: the literary text evokes a (fictitious) world in the mind of the reader. If the reader is unable to imagine

this world, the literary work is a failure. On the other hand, says Ingarden, graphic representation is not a criterion of a scientific work – indeed, it is irrelevant. The reader is not required to make a mental picture, but has simple to *look* at what is 'before his very eyes'. True enough, science sometimes deals with phenomena that cannot be seen (literally?) by the body's eye but only (metaphorically?) by the mind's eye. In such a case, the researcher creates models, which help the reader to visualize ('bring to mind') and so to come to a better understanding of the written word and thus of reality. Though this may seem to contradict Ingarden's stance on the irrelevance of visual representation, he denies it, since the principal aim of making models lies not in the models themselves nor in the representations they evoke, but rather in what lies behind it all: that to which the models refer.[47] The images and representations summoned up by the use of models are no more than an 'insignificant by-product', not even noticed when the text is read properly. The representations are 'transparent'(154): actually 'they do not belong at all to the reader's field of vision. Once the *meaning* of the text has been established (that of the words as words) the *content* of the text (of the message) is 'taken up into the thought processes and is just simply (*einfach schlicht*) thought'. We could say: that which is *said in* words is now *seen without* words. According to Ingarden: if 'that which the text signifies' becomes the actual object,(164) or is indeed seen, the operation of making the reader understand the text has 'worked'. Thanks to scientific language the reader can see reality, truth. Scientific writing speaks the truth, it states what is. In scientific writing sentences lacking truth statements are therefore unimportant; they should be ignored as much as possible.

The literary text speaks no truth. It states no true propositions. Of course, statements of truth do appear in a literary text, but they are valid only within the (fictitious) world evoked by the text. They do not pretend to be valid or true when they are removed from their context. Even if some sentences happen to be true out of context, they still do not function in the text as a proposition in the logical sense.

Ingarden wants to impress upon us that literary and scientific writing require different acts of reading. In reading a literary text, which is an extremely complicated act demanding great mental effort, attention should be centred on the text, on the images and on the many meanings evoked by the text. But when it comes to reading a scientific

[47] M. Black (1962).

text, the reader must on no account dwell upon the text itself. No attention must be paid to anything standing in the way of a simple understanding of meaning, to anything, for instance, that could induce an emotional attitude. For, such an attitude will influence acceptance or rejection of the statements, the propositions or the judgements contained within the text. Emotions obfuscate logical judgement.

Yet Ingarden also has to admit that the boundary between scientific and literary writings is not watertight: despite every precaution scientific texts are ambiguous. Scientific authors will never succeed in completely banishing literary elements from their writings: texts of this kind need a minimum of vocabulary borrowed from inexact ordinary language. Even in the purest research treatises there are 'alas' words with a decisively emotional burden, arousing feelings. This is regrettable, since it prevents any scientific piece of writing from *forcing* the reader to comprehend the text in one single way. The reader is placed in the position of having to *decide* which interpretation is correct. In this context Ingarden pleads with scientists to develop some linguistic feeling for language. Scientists with little experience of reading, will be quite unaware of the enormous influence exerted on them by their own habits of speech and are likely to extract from their reading matter whatever happens to enter their minds while reading. Readers of this kind even fail to realize that the text could be taken to mean something else! Ingarden recognizes the power of language and therefore warns scientists to be on their guard.

True enough, in well-written scientific texts, according to Ingarden, often one single interpretation emerges as the most likely.(163) But in unclear, badly written texts it is difficult to come to a decision. In such cases it can become necessary to acquaint oneself with other works by the same author. But he has to admit that the problem of an unequivocal comprehension of the text is thereby shifted to that of an unequivocal comprehension of the author's entire opus. The danger of loss of the sense of reality looms again: 'Will it ever be possible', he asks anxiously, "(...) to reach the solid ground of unambiguity in all this wandering and meandering?"(164)

Sometimes a text is so obscure that an unequivocal comprehension of it proves impossible, even if we are familiar with the entire oeuvre of the author in question. What to do in such a situation? Can Ingarden ward off the crisis? Of course not. The reader has to resign himself to the multiplicity of possible meanings and must keep all the various interpretations in mind. And so we are back to square one. It never occurred to Ingarden that the *reality* allegedly studied and described by science is perhaps not as unequivocal as is thought.

There are scientific texts, he continues, that are difficult to understand for reasons other than lack of clarity of their language: texts describing such innovative research that the existing language cannot cope with it. These are the writings of creative scientists pursuing pioneering research. Such texts are the most difficult to fathom. Do innovative scientists tend to be careless in their use of language? Are they less able to write clearly than the average researcher? Or do the texts they produce contain no statements of truth to provide us with a solid basis? Ingarden explains that the real problem is that such texts cannot be written in (clear) professional language current at that particular moment. A first requirement for a rewarding reading of a scientific work is mastery of a professional language, a language passed on from one generation of researchers to another. But when an innovative scientific text requires reading, the paradoxical situation arises of researchers having to forget this language.(167)

At this point in his argument Ingarden comes very close indeed to discovering that the language — the habits of speech, the standard expressions and the metaphors — used by scientists perhaps *generates* the reality which they are attempting to 'describe'. But Ingarden fails to notice that possibility. In reading a creative scientific work a *temporary* loss of language and sense of reality is a condition of grasping the newly discovered reality. Ingarden ends his reading instructions to scientists by outlining what they should do, when they can make neither head nor tail of a text. What can be done when a text fulfils its referential function so badly that readers, particularly those who have followed all the reading instructions, are unable to find a single sensible opinion in it, even after having familiarized themselves with the whole of the author's oeuvre? In such a case, they must rely on themselves and, based on their own experiences, determine where the text makes contact with outside reality. But in our reading of *The Origin of Species* we have seen where that strategy can lead to: to the scientist's own social reality. We have also seen that the recourse to one's own experiences was a powerful rhetorical device: in Darwin's work nothing seemed more convincing, nothing more tempting, than the writer's appeal to experiences of his nineteenth-century readers.

Ingarden is clearly aware of the power of language: its capacity to distract, to tempt towards pleasure, to cause confusion — the power of the *femme fatale*. Language should exercise such power in literature, but not in science. The less conspicuous the manner in which the scientific text accomplishes its task to refer to reality the better. However, now that, since the sixties, we have learned to think

differently about science, we must also learn to think differently about language in science and the reality it purports to study.[48]

5.2.3 *The contemporary scientific paper*

Did the natural scientists ever take heed of Ingarden's warnings to pay close attention to the texts they were to write and read? It seems highly unlikely. Given the compartmentalization of knowledge there would have been little chance of Ingarden's suggestions ever reaching scientists. But more importantly, in the actual praxis of science, writing and reading texts do not seem to cause any problems. Since the late nineteenth century, papers in the many fields of natural science have acquired a set of features which strongly reinforce the impression that scientific language is crystal clear and its understanding unproblematic.

Firstly, scientific papers have acquired a set of specific stylistic features of their own. As Gyorgi Marcus points out in "Why is there no hermeneutics of science"? (1987), not only do they have a referential and non-literary style, a *sec* description of the scientist's dealings with his objects of study, but they are also strongly 'authorial': the author (or a collective of authors) signs his text, indicating that he is responsible for its content and that it is his intellectual property. On the other hand, and in apparent contradiction, the texts are at the same time 'depersonalized' by the frequent use of 'we' and by using the passive voice which suggests sequences of events following each other, without the intervention of the experimenter. The abstention from value judgements and emotional and normative expressions underlines the strategy of depersonalization. By these stylistic devices the author presents himself as "an autonomous performer" of strictly regulated activities, and as "a detached observer of their results".[49]

[48] Given the resistance against abandoning the belief in the separation of scientific and literary writings, and reality and language, it should come as no surprise that in addition to ignoring the text as described by Ingarden more strategies have been developed to help us to avoid this. A second strategy held up to us is the suggestion that our knowledge of 'the' reality might as yet be *incomplete*. Such an idea about the present state of science raises hopes that by collecting knowledge we might be *on the road* to reality and to 'the truth'. A third strategy to help us avoid doubts about the existence of 'the' reality and 'the' truth is the concept that the existing image of reality which, in principle, can also be falsified, is based on faulty observations and/or conclusions – in brief, on *errors*. This enables us to hope that it would also be possible that we are *not* mistaken. While it is true to say that those scientists who adhere to the theory of instrumentalism, and many representatives of anti-realism in the philosophy of science, have abandoned the illusion that we can know 'the' reality or are at least on the right road towards it, nonetheless our culture as a whole has remained unaffected by this development.

[49] G. Marcus, (1987, p.13).

This literary device of depersonalization contributes furthermore to the status of the text as a non-literary, non-rhetorical, strictly factual report. Thus science itself appears as an impersonal and interpersonal praxis. Whoever, in writing papers, does not conform to these stylistic devices, indicates that he/she does not belong to the scientific community. In science, like everywhere else, linguistic boundaries indicate the boundaries of the community.

Secondly, natural science papers have a specific structure. They begin with an introduction giving a selective survey of contemporary literature on the research. In making this survey, the author transforms the varied and more or less chaotic material into a "single, but partial and open-ended argumentative complex".[50] He puts an objective current state of affairs before the reader's eyes — a state of affairs which by itself seems to pose certain (objective) questions, the questions to which the paper will try to provide the answer. The author's description of the state of affairs also serves as a legitimation to the paper's claim to originality. The introduction is usually followed by sections on the methods used, and on the subsequent results. The results obtained in the experiments seem to originate directly from nature. The paper ends with a discussion. If there is a choice of alternatives, a preference is stated. In this way the author shows a broadminded awareness of alternatives and indicates roads for future research.[51]

The depersonalization strategy and the tactics to describe an objective state of affairs in science and nature reduce the status and presence of the author. Compared to a writer like Darwin, the contemporary scientist's control over the meaning and importance of the paper seems minimal. The rhetoric of the text ('this is science', 'this is credible', 'here are the facts') has been made invisible: it is implied by the conventional style and structure of its genre, rather than put into effect by inventive strategies on the part of an author trying to persuade the reader.

Thirdly, in using specialized language, natural science papers are highly effective in limiting their readership to a small circle of insiders: the professional scientists who can understand and speak the same language themselves. Scientific language creates insiders and outsiders.

The outsiders, notably the non-professionals, stand in marked contrast with the small target readership. The use of specialized

[50] Ibid., p.37.

[51] On the structure of contemporary scientific papers cf. also K. Knorr-Cetina (1984, pp.174-244).

language indicates that they are not treated by the authors as equals but as mere 'client-users' who are interested only in the final product, the results, or the information that the paper contains. They are expected to accept, and not to judge, the results on the basis of the author's authority — on his word. In this way laymen are excluded from science and scientists can continue to claim autonomy. The writing and reading of contemporary scientific papers, it turns out, is based upon a (fairly limited) number of linguistic conventions or 'fictions' readers have to know and to accept.

We may conclude from Marcus' analysis that even the pretention of a radical separation between contemporary scientific and literary texts is an effect of language, a *rhetorical* effect — a *literary fiction*. The boundary line between such a scientific text and reality, or between mediated second-hand and immediate first hand experience, is vague.[52]

Why can the natural science text nevertheless maintain its 'hermeneutic innocence', and continue to pretend clarity in the face of a growing number of innovative and influential studies arguing (for good reason) that the reality studied by science is at least partly the product of its own discourse instead of being simply the product of the direct contact with nature herself? Because of the impact of those in power who want to keep their and their readers' eyes closed? Or because by and large science satisfies the needs, demands and dreams of our culture? As long as science fulfils that function — and I think it still does[53] — criticism, however to the point, will be mere pin-pricks in an elephant skin. In other words, the longstanding belief in the separation between reality and language, and the lack of interest in natural science texts as texts *per se* is, in the final analysis, symptomatic for the basic orientations in our culture: its need for a foundation for truth and for a techno-scientific approach to what we call 'nature'.[54]

[52] B. Latour and S. Woolgar (1979) have show in detail how the actual text of scientific papers is the outcome of negotiations between scientists in the laboratory. The described reality is, at least partly, the outcome of deliberation, that is: a 'constructed reality'.

[53] cf. also R.D. Romanyshyn (1989).

[54] G. de Vries (1990) calls such people who, hoping to discredit a development in science they disagree with, draw the attention to the literary devices used in scientific writing 'bad losers'. In his words: "When the rules of the language game are finally accepted they disappear from sight. Whoever then still maintains these science's success in stating brute facts relies on the acceptance of a specifics language praxis and on the usage of techniques that are in itself controversial is a *bad loser* – like a supporter who points out that the other part's goal is merely valid thanks to the rules of the game" (p.54). I would prefer to call them *perceptive critics*.

The lack of interest in scientific language will continue till other needs, desires and dreams (new discoveries in science? environmental concerns? feminist studies?) arise which require alternative ways of envisioning the relationship between reality and language, science and literature. Such changes are bound to come for history goes on — but they may take time. Are late twentieth-century proposals for another relationship symptoms that such a change is already under way?[55]

5.2.4 *Some personal remarks*

Till very recently hardly any attention has been paid to the productive function of language — no matter how curtailed — in scientific writings. My own study of the reception of the ideas of Darwin and Freud in The Netherlands, for example, was started without any idea of the role played by the language which these authors used. Even at the symposia held in Washington D.C. in 1972 and 1976 on the reception accorded to respectively Darwin's theory of evolution and Freud's psychoanalysis in various countries, not a single participant brought up the question of language.[56] Only gradually, when working on the material I had gathered, with particular reference to the reception accorded to Freud's ideas in The Netherlands, did I realize that a systematic study of his language could be important in reaching an understanding not only of the history of psychoanalysis but also of psychoanalysis itself. To what extent, I began to wonder, is it possible to separate the theory and practice of psychoanalysis from the words in which they are expressed? What was the relationship between Freud's language on the one hand and his new science on the other? It seemed likely that a relationship did indeed exist: it is impossible to practice psychoanalysis without the use of terms like libido, sex, Oedipus complex, repression, regression — all imaginative and rhetorical *terms* which held as little scientific neutrality for Freud's contemporaries as they do for us. From the very outset they aroused strong positive reactions in some readers, while others rejected them with equal vigour. The same could be said of Darwin's theory of evolution, as I subsequently realized.

At first I thought that the enormous variety in the interpretations of Freud's work could to some extent be explained as deriving from the (metaphorical) 'spectacles' worn by his readers: some elements in Freud's work answered a need felt by his readers. The psychiatrist Jelgersma, professor at the University of Leiden, for instance found

[55] See postscript of this study.

[56] Th.F. Glick (ed.) (1974); Ilse N. Bulhof (1983).

support in Freud for his liberal tendencies, his colleague of the protestant Free University of Amsterdam Leendert Bouman welcomed psychoanalysis for the return of the soul and August Stärke, a psychiatrist at a psychiatric institution and one of Freud's most original followers, appreciated its recognition of sexuality.[57] As exponents of the post-Kantian era we are familiar with the fact that readers do, indeed, don such spectacles. And the sociology of knowledge and of science teach us that knowledge and interests are closely intertwined. However, when we state that a liberal like Jelgersma reads Freud with liberal spectacles, we are tacitly assuming that the meaning of Freud's texts is more or less fixed and that the reader merely gives a particular twist or shade to that meaning. But this explanation is absolutely inadequate for interpretations which appear at first sight to be totally incomprehensible. Some interpretations of Freud's work seem at first glance to be not so much the result of a coloured view as of hopelessly inadequate reading; in other words, of allowing the imagination free rein.

A re-reading of Freud's work and a closer biographical reconnaissance shows, however, that such readers have occasionally noticed something in the master's writings which is really there, something that we are inclined to overlook. His evocative and rhetorical language and the ambiguities hidden in his text made — and still make — it possible to interpret Freud in various ways — even leading to interpretations which we feel are wide of the mark. This is not the place to pursue this matter in detail, but it may be helpful to know that the same phenomenon of 'impossible' interpretations has occurred more frequently, for instance in connection with Kant's work.

In their study of Kant entitled *Das Andere der Vernuft* (1983), Hartmut and Gernot Böhme show how Kant's early dynamic theory of matter (based on the forces of repulsion and attraction in nature) was perceived in the philosophy, the medicine and the literature of the romantic period as the structure of living matter in the organic world. Later criticism rejected such 'romantic' interpretations as 'perversions' (*Verkehrung*) of Kant's 'actual' thinking, and disqualified such readings as irrational, as a relapse, or mere exaggeration.[58] However, according to the Böhmes, such a reaction leads to ignoring elements that represent authentic constituents of Kant's philosophy. The later Kant's own repression of his erotic feelings resulted in this type of romantic

[57] Ilse N. Bulhof (1983).
[58] H. and G. Böhme (1983, p.174).

element having no place in his later discursive exposition, and what Kant was 'actually' trying to say is usually deduced from this later exposé. In other words: interpretations which deviate wildly from the general consensus can be a valuable indication or a symptom of concealed textual elements. Discovering the appropriate meanings of a phrase is therefore helped by observing the reactions of the reader or listener.[59]

This basic ambiguity of the spoken and written word prompted me to widen my research and not only to concentrate on scientific writings by authors with acknowledged literary talents like Freud but also on other academic texts — historical,[60] socio-scientific texts, even texts from the natural sciences. All such texts might contain more than just the words on the page, whether it be thinly-veiled psychological, or ideological meanings.

Thus after an interval of several years I settled down once again to read that classical text of the history of science: Darwin's *The Origin of Species*, and only then did I realize its richness from a rhetorical and literary point of view, astonished at my original oversight in this regard.

5.3 Moral and Political Importance of the Separation of Literary and Scientific Writings

Fear of rendering reality unreal has led to our being indoctrinated from our earliest years, *vide* Ingarden, to separate literature from science. As participants of this culture we are urged to pick up a so-called literary work in order to 'distract' ourselves to a higher level when indulging in reflections on the meaning of life, or to lower level when immersing ourselves in escape literature. We should read literature in order to "liberate ourselves", if only momentarily, from harsh reality surrounding us and to free our spirit from the suffocating demands made on us by everyday living. We should read in order to allow ourselves to be carried off to another world — a world of the future, happy or strange, or to a superior or horrific universe, a place which, seen from our own point in time or from our earthly abode, is *fictitious*. Once we close the novel or the collection of poems, we should return to the 'ordinary' everyday world, to 'reality'. Based on the concept of literature as fiction, literary authors are allowed free

[59] cf. J.J.A. Mooy (1976).
[60] cf. H. White (1973).

reign to write and fantasize as much as they wish. In democratic societies, we proudly proclaim, thoughts are free (there are endless ways of filling in the balloons above the heads of comic strip figures); everyone is allowed to say or write what he or she wants. In assuming that literary writers are merely fantasizing when writing, and meanwhile, in their daily lives, live in exactly the same reality as we, ordinary readers, we *support* the belief in reality as being situated outside the literary text, a reality where two and two is four, where stones do not fall upwards and where people 'just' eat, drink, hopefully love, and most certainly die. This belief, that it does not really matter what literary authors write because the world is as it is, takes the sting out of literature. In basing ourselves on a sort of fundamental external reality which is supposed to be the same for everyone, and from which ultimately no-one can escape we contribute to the devaluation of literature to mere fiction.

But if literature and reality are so tenuously connected with one another, how can a well-written piece of literature sometimes cause enormous political upheaval, like *Uncle Tom's Cabin* by Harriet Beecher Stowe? Why was the political significance of literature held in such high esteem in the former Eastern bloc countries? Is it simply because there the authorities did not allow freedom of speech, and the only form of criticism possible was in the veiled form of literature? I believe that the reason lies much deeper. Important moral and political reasons may exist for holding on to this conception of literature. By way of hypothesis I would like to suggest that the low place assigned to literature in the Western world and the high place accorded to it in the former socialist republics, and the separation between, on the one hand, literature and fiction and, on the other hand, science and reality in the West, ultimately stem from a marked difference between East and West in *political* philosophy. Making this hypothesis credible would require the collaboration of political and cultural historians. Because the difference between East and West in this regard may draw the attention to the *danger* that a *one-sided emphasis* on the productivity of language carries with it: the danger of *despotism*, I would like nevertheless, to support it briefly with the following considerations.

In the tradition that since the fall of the Roman empire became dominant in the Western half of the empire, rulers and ruled have, from the very start, respected principles situated above human authority, whereas in the tradition that became dominant in the eastern half of the empire, the Byzantine sphere of influence, the typically Roman notion that authority is located in the word spoken by the

emperor has been followed. It has been a striking feature of medieval Western historical development that emerging aspirations for absolute power have been curbed because a right to resist, when certain principles, such as the oath binding vassal and lord were violated, has been acknowledged. The most striking example has been the granting of Magna Charta by the English king to his barons in 1215. This document granted personal and political liberty and precluded arbitrary despotism. Similar appeals to the right to resist were made during other rebellions, such as the revolt of the seven Dutch provinces against Philip II of Spain, the English Glorious Revolution of 1688, and the American and French Revolutions.

Other features of Western historical development may also be kept in mind: the struggle between pope and emperor in the Middle Ages which ended in the mutual acknowledgement that each had jurisdiction over his own realm only, the pope the spiritual, the emperor the secular; the struggle of laymen against the clergy, and that of the lower clerics against the papacy and higher ecclesiastics.

These political struggles have in common that absolute power has been consistently resisted with an appeal to something that could not be infringed upon by human beings, be they emperors, kings or popes. Only in the modern period have Western kings succeeded in introducing the principles of Roman law into their kingdoms, and proclaimed absolute power (cf. 'the divine right of kings'). In the long run, however, the absolute power of kings and popes proved in our part of the world to be merely an episode in the long development toward forms of non-despotic government.

In Eastern Europe, in contrast, the Roman tradition that the sovereign is the source of law prevailed. What is the law and what is the truth was decided by the emperor or tsar, or in our century, the communist party. Law and truth were decided by means of the sovereign's *words*. In view of this background it is not surprising that an important impetus toward the sociology of knowledge came from Russia in the 1930s.[61] For according to the sociology of knowledge, those in power decide directly or indirectly what will count as 'truth' or 'reality'.[62]

The struggle against Aristotelian verbalism and humanist rhetoric on the part of empirical scientists, such as Boyle and rationalist scientists such as Galileo, and the substitution of 'direct' knowledge

[61] See note 46 on page 151.

[62] cf. also M. Foucault (1966, 1980, pp.199-233).

of nature for bookish knowledge should, it seems to me, not *only* be seen in the petty local historical framework of the local English Restoration scene or of Italian churches intrigues,[63] but also within the larger framework of the honourable liberal political (metaphysical?) tradition of Western anti-despotism. What nature is, this tradition suggests, cannot be decreed by human beings, be they rulers or scientists. It should be discovered in patient research. The findings of individual scientists, Boyle insisted, should be discussed with fellow-scientists in a rational and civil manner, till they are able to agree upon what is a 'matter of fact' and what is not. That 'nature', to whose laws Boyle and Galileo appealed, was placed outside the reach of political discourse is in line with this liberal interpretation ultimately inherited from the ancient metaphysical tradition. This larger framework, positing a truth that is to be contemplated and discovered rather than made by human agency, helps to explain the appeal of Boyle's project for experimental science based upon an 'authoritative' transcendant reality and civil discussion on 'what to make of it' — an appeal it still has.

Ever since the seventeenth century the rhetoric of the West has made even governments bow before the authority of 'reality' and 'facts' as established by scientific method. Authorities based on words and making themselves known through words (and 'therefore' human and arbitrary) were, and are, no longer accepted as final arbiters in questions of truth. In such matters the authority of 'reality' and 'facts' applied not only to the natural sciences but also to the later social sciences and, for instance, journalism.[64] That is to say that the typically Western separation between literature (in the sense of fiction) and science (in the sense of objective description of objective reality) is of extreme moral and political significance — for human society, that is to say. Nature is no part of it.

After the scientific language and the ontological view it presents have become taken for granted, and the language of science has penetrated other areas of human life (economics, history, journalism, politics) it became generally believed that in all these areas the language directly flows from reality. However, for a variety of reasons the beliefs in a cognizable reality and human beings capable of

[63] In the eyes of S. Shapin and S. Shaffer, experimental approach and the concept of nature it implied was meant to be an example for a country torn by civil strife of how to end disputes peacefully, and how to safeguard certain areas of knowledge against the interference by the powers that be.

[64] A. van Zoest (1980, pp.63-65).

knowing it, are nowadays fading. Consequently, the door is opened for 'anti-foundationalist' (anti-metaphysical?) research showing the human all too human (ideological) origin of the 'construction' of a reality outside human language and praxis. We are now made to see, reluctantly perhaps, that Darwin's view of evolution or Boyle's conception of scientific knowledge were not simply the triumph of truth over error, but that they were deeply implicated in the local circumstances prevailing at the time. Not truth but politics or interests are said to have been the decisive factor in the success of modern natural science. The pretension of science to tell the truth is portrayed as a mystification. But are we in this regard faced with a choice between *either* truth *or* mystification? Might not a *middle ground* exist where science and the reality or nature it studies can be viewed as *simultaneously* subjective and objective?

Rebelling against the authority which science and the political establishment connected with it in our industrialized political economies have in our culture, some students of the history of science like Shapin and Shaffer opt for the position, in the seventeenth century already defended by Boyle's contemporary, Hobbes: that not a phantom nature or reality, but the highest *political*, and that is also: *human*, authority, be it king or parliament, has and should have the power to decide what reality is like. They rally behind Hobbes and reject Boyle. Shapin and Shaffer formulate their choice in the last words of their study:

> As we come to recognize the conventional and artificial status of our forms of knowing, we put ourselves in a position to realize that it is ourselves and not reality that is responsible for what we know. Knowledge, as much as the state, is the product of human actions. Hobbes was right.[65]

In my opinion, however, this option represents a resurgence of an in essence despotic tradition in which the word of the emperor is law. As much as I agree with their analysis of the 'artificial status of our forms of knowing', I strongly reject the last part of their conclusion: that Hobbes was right. Language is creative and 'productive' — but not to the extent that, like a sovereign, a human speaker could decree what is 'real' and 'true' and what is not. We should therefore not allow ourselves to be forced to choose between two extremes: the one being science and scientific realism affirming that truth comes from elsewhere, for example, from nature investigated by science, the other

[65] S. Shapin and S. Shaffer (1985, p.344).

being anti-realism, affirming that truth is constructed by human language.

Perhaps these extremes do *not* have to exclude each other. That they do is nowadays suggested in the context of liberal industrialized democracies in which two parties claim authority over nature: scientists and politicians. But as will be suggested in the next chapter, nature might serve as *a support for various discourses and interpretations*, depending on, among other things, the ways *we* approach and address her, and on the ways *she* responds.

Awareness of the negative effects of modern science and justified questioning of the boundary between science and literature should not bring us back to those sophists who in Classical Antiquity maintained that might makes right, nor to absolutists in their old or modern variants. Indeed, precisely in order to avoid this consequence I would like to propose focusing not only on *language*, seemingly the attribute of human beings only, but also on what according to the modern perspective, is our other: *nature*. That is to say I would like to tackle again questions of ontology.

The separation between science and literature has never become absolute. In a situation in which realism and anti-realism,[66] or science and fiction, or again: mute nature *discovered* by science and sovereignty of speaking human beings *making* nature seem to be the only alternatives open to us, the presence of literary elements and literary strategies in scientific texts requires a new importance. By confusing the neat boundaries between science and literature, their presence confuses the ontology that those boundaries produce. It might therefore mean that not only human beings speak, but that somehow nature, too, is expressive. In the following chapter the problem whether we can form some idea of an *interaction* between language, — in particular the language of scientific writings, and what is represented by that language, 'the reality' supposed to be outside the text , — will be examined.

[66] For an excellent introduction to the problems of realism and antirealism see I. Hacking (1987).

CHAPTER SIX

LITERARY LANGUAGE AND EVASIVE REALITY: TOWARD A HERMENEUTICAL ONTOLOGY

6.1 PRELIMINARY REMARKS: LANGUAGE AND ONTOLOGY. THE HERMENEUTICAL-RHETORICAL TRADITION

We have come to suspect a relationship between the use of the exact language which in the scientific praxis minimizes the influence of human perspective and works against a sense of involvement, and the degradation of nature to a mute anonymous object. Natural science language expresses and reinforces an ontology that separates speaking subject and mute object. In this sense we understand the anvil hammered upon by contemporary sociology of science: that the discourse of modern science 'constructs' the nature it studies. But this position makes 'nature' herself seem irrelevant, it makes her all but invisible. The insight that a *relationship* exists between language and reality should alert us therefore to the task of inquiring into the kind of *interaction* between them. In this last chapter I would like to offer some suggestions as to how this may be done. Let me first indicate in broad outline four interrelated issues that need to be explored.

First of all, given the existing awareness of the separation between language and reality, there is the issue of *reality*. What is reality like that it can be creatively mediated ('constructed', 'produced' or 'generated') through language? In other words, ontological questions need to be tackled again. Secondly, given the still prevalent opinion that science somehow makes a realistic picture (representation) of nature, there is the issue of *representation* in science. Could nature perhaps be represented in science in the *political* sense of the word: giving nature a chance to 'speak' or 'express herself' again and translating what nature has to 'say', finding ways of making sense again of the old expression 'language of nature' — that is to say restoring some kind of agency and expressivity to nature without falling back to primitive forms of animism? This leads to a third issue suggested by the prevailing belief in the separation between *literal and figurative speech*. The ingrained conviction of a separation of non-human nature and human language, science and literature, threatens to weaken any suggestions of a 'speaking' expressive nature as anthropomorphic, as

harmless 'merely figurative' talk. It stands in the way of, for example, widening current notions of language to include other expressions besides words. Could 'language of nature' be more than 'figurative language'? Fourthly, there is the issue of *scientific language*. Given the prescription for exact and propositional language of science, a yes-no style of referential thinking is imposed which leaves no room for interaction between speaker and object spoken about. Scientific language is a speaking-about from a distance. Could a reintroduction of forms of poetic and rhetorical speaking into the study of nature perhaps offer possibilities to stimulate the re-figuring of the relationship between language and reality, for example, by expressing and reinforcing partnership with nature?

In exploring these issues, I find the *hermeneutical-rhetorical tradition* an important source of inspiration. It may open our eyes to aspects of the scientific enterprise to which modern science blinds us: the interaction between the students of nature and the object of their study, and the moral aspects involved in this interaction.

Hermeneutics is the discipline or 'art' (craft) of reading and interpreting texts. During the Reformation period texts acquired for several reasons a new importance: the interpretation of the Bible stood at the centre of the conflict between reformers and church; deficiencies of medieval Latin were discovered by the humanists, who were engaged in reconstituting the original text of Holy Scripture; and the multiplication of texts by printing made the presence of good master copies an urgent requirement.

Generally speaking, text interpretation aims at translating the meaning (message) of a text that at first glace seems alien and distant.[1] Only a translated meaning can be understood and appropriated by reader or audience. The emphasis on the role of the interpreter who mediates between text and audience connects the hermeneutical tradition of interpreting written texts with the classical rhetorical tradition, which, taking its point of departure from the speech situation, paid much attention to the role of the audience. During the nineteenth century, however, hermeneuticists lost their feeling for the presence and role of the audience, that is to say for the rhetorical aspect of texts. In Gadamer's hermeneutical philosophy attention for the rhetorical aspect of hermeneutics resurfaced.[2]

[1] cf. Ilse N. Bulhof (1980).
[2] A.K. Dockhorn (1980).

Although the modern period brought hermeneutics to the fore, its roots go back to Christian Platonic and medieval philosophy.[3] During those early times hermeneutics did not only occupy itself with the interpretation of written texts, but also with 'reading' the 'text' of nature. Holy Scripture and nature were considered equally 'meaningful': both revealed their Author and His message. Both 'books' intended an effect: they admonished their 'readers' to praise their Author and to put their lives into His service. In that sense both 'books' were rhetorical. After being discovered to be a text written in abstruse mathematical language the rhetorical aspect of the 'text' of nature stopped being a point of discussion. The contemporary rediscovery of the rhetorical aspects of scientific texts and praxis makes it interesting to investigate what the presence of those rhetorical strategies might imply both for the *study* of nature and for the *object* of that study: nature.

Although the medieval impulses for a genuinely hermeneutical-rhetorical philosophy have been supplanted by other philosophical orientations, to begin with nominalism, the hermeneutical-rhetorical tradition has remained a constant undercurrent. Because of its emphasis on the mediating role of language in ontology and on the role of the audience in validating truth, the hermeneutical-rhetorical tradition may help us to find ways, appropriate to our contemporary situation, to bring together what has been so ruthlessly separated and antagonized in modern thought: subject and object, language and reality, the worlds of human beings an of nature.[4]

This chapter will first provide a brief historical sketch of the vicissitudes of the metaphor of the book of nature. Following the leads offered by the hermeneutical-rhetorical tradition, I shall then offer some reflections on a possible rapprochement between contemporary literary theory and ontology. The point of departure for this reapproachment will be the ambiguity or *polysemy* that may characterize not only a literary text, e.g. a poem, but also nature. The ambiguity of the phenomena of nature may give scientists an interpretative freedom, which may be compared to the freedom of a receptive reader in interpreting polysemous literary texts. In the last section of the chapter an outline of my proposal for a hermeneutical ontology will be presented.

[3] P. Kockelkoren (1991A) suggests that hermeneutics took its departure from pre-philosophical sooth saying practices. He skips, however, its flowering in medieval philosophy.

[4] See also D. Böhler (1981).

6.2 THE BOOK OF NATURE IN THE HERMENEUTICAL-RHETORICAL TRADITION: HISTORICAL BACKGROUND

The notion of nature as a book seems outdated. That nature has no meaning — is not a book — is nowadays taken for granted. To give some examples: in his *Knowledge and Social Imagery*, David Bloor states that the approach to science advocated by him is based, among other things, on the desire for a conception of the natural world as morally empty and neutral.[5] Richard Rorty's pragmatism takes a meaningless or neutral nature for granted.[6] Hans Blumenberg remarks in *Die Lesbarkeit der Welt* (1981) that we find it difficult to become aware again of what exactly people had in mind, who considered nature to have a meaning like a book, and what could possibly be lost by its denial. To talk about meaning in/of nature as if she were a text or a book could be excused as 'pre-scientific' for the period before the rise of modern science; it is regarded today as decidedly un-scientific. For the hermeneutical-rhetorical tradition has remained open to the possibility of a meaningful nature. We may distinguish five forms this tradition has taken.

According to the medieval worldview the world was regarded as God's creation. At the heart of all created things were God's creative thoughts, comparable to the Platonic Ideas. Hence the Christian view of the world as a 'text' written by God.

The metaphor of the Book of Nature was first mentioned by St. Augustin.[7] The Latin father of the Church strove to take an equal distance from Neo-platonic emanation philosophy and from gnosticism. God has created not only the book of Holy Scripture, but also a second book, that of nature. By analogy with the Bible, nature in the Augustinean tradition came to be seen as a text speaking of its author in a non-verbal way, in symbols.[8] This was the origin of the hermeneutical-rhetorical tradition. The world is not pure evil, as gnosticism maintained. But the world is not in essence rational and knowable either, as the metaphysics of Plato and Aristotle stated. But it is beautiful and calls us back to its Author. St. Augustin emphasized that God had created or invented the world by his thinking. As to

[5] D. Bloor, knowledge and social imagery (1976, pp.9-10).
[6] R. Rorty (1989).
[7] H. Blumenberg (1981).
[8] For this metaphor see H. Blumenberg (1981) and Ilse N. Bulhof (1990).

'think' the world and to 'make' it are identical for God, he concluded that the world cannot be a *datum* that can be known by us, being outsiders. Only the Creator could fully know the work of His hands: the being and meaning of the 'text' he wrote. As a book, creation's being and meaning transcended its visible structure, its 'letters'; they could not be fully discovered.

During the twelfth and thirteenth centuries, the book-of-nature metaphor flourished again. It was taken up by Alanus de Insulis (1120-1203) and Hugo of St. Viktor (1096-1141). 'The whole world is to us like a book and an image, like a mirror'. (*Omnis mundi creatura / Quasi liber et pictura / Nobis est et speculum*), according to the former. Everybody thinks the world is marvellous, wrote Hugo of St. Viktor, although the illiterate can admire only its exterior shape, its letters, while the spiritual person senses in its beauty also the wisdom and the call of the Creator, its epistemological and moral meaning.

The most extensive treatment of the metaphor was given by St. Bonaventure (1221-1274) in *The Work of Creation* (or *Hexahemeron)* and in *Breviloquium*, both written around the middle of the thirteenth century. According to this third resumption of the metaphor, creation is a kind of book in which the productive capacity of the Trinity is illuminated (*creatura mundi est quasi quidam liber in quo relucet (...) Trinitas fabricatrix*). The first book, that of creation, had been darkened by the fall. Thanks to the coming of Christ man can find again the right relationship to the Triune God and to all created things, man's fellow-travellers in salvation history. The revelation in Christ as told in the New Testament helps man to cooperate in the history that began with creation and will end in the reparation of creation's fallen state. Characteristic for this tradition is again that it considers nature as *more* than is visible, as *more* than just 'literal', and *more* than can be comprehended by man. As a text, nature's individualities have within an invisible, hidden being and significance given by God, who expresses Himself in his creation. But however hidden, nature's being and significance are not totally uncognizable. God's creational Ideas can be surmised by us and tentatively expressed in words. Thus, we might say, nature (creation including man) can be *translated and expressed* in human language *because she herself is expressive.*

Although the metaphor plays a role in the thought of later, mostly Franciscan, thinkers, such as Nicolaus of Cusa, it lost its central position as a reference point in philosophy.[9]

[9] H. Blumenberg (1981, pp.47-57).

The notion that God expresses himself in the creational Ideas that are at the heart of the present world was shorn away by Ockham's razor. The idea of creation became reduced to the notion that at some time the world had been called into being by God's creative act. In the world in its daily travails between creation at the beginning and re-creation at the end of time, nothing could be read concerning its intrinsic being and significance, or its creator. Nature did not express anything. By the same token, human language lost the expressive power vis à vis nature.

In fourteenth-century Italy, a period still belonging to the Middle Ages *qua* date, but to the early Renaissance *qua* culture, we find a fourth resumption of the hermeneutical-rhetorical view of reality.

The fourteenth-century Italian humanists ascribed a more active — and more secularised — function to human beings as readers of the book of nature: the function of *creative readers* of the text. According to this interpretation, in capacity of interpreter of the given world, is are makers of cultural worlds and history[10] As Ernesto Grassi points out in his study of the humanist position, the essential elements leading to the typically human world were considered to be work and fantasy: "Work", he writes, "is the continuing attempt to meet human needs through the means provided by the *artes*. Experience teaches us that the various needs and questions that stem from human freedom (insofar as man, in contrast to animals, is not bound to innate schemata through which nature is interpreted), from the *archai* or presuppositions of *every* (my *italics*) interpretative activity on the basis of which work becomes possible".[11] For Dante, he continues, inventive and metaphorical activity lies at the basis of *all* work, "be it material or intellectual effort through which we strengthen our existence".[12] This includes getting to know our world. Inventive and metaphorical activity are at the roots of our practical knowledge of the world on which we base our actions. The typically human phenomena of culture and history find their origin in metaphorical activity, "seeing the similar", which involves a logic of its own (the "logic of metaphor"). The view that the human world is interpreted and given form by the activity of the creative imagination working on given elements is no longer connected with Christian belief. On the contrary: it indicates the extent

[10] E. Grassi (1980, 1984). The use of the word 'creative'and 'creativity' in connection to human activity dates from the much later Romantic period.

[11] E. Grassi (1980, p.87).

[12] Ibid., p.100.

to which the humanists were indebted to the rhetorical tradition of Classical Antiquity.

Giambattista Vico was the seventeenth-century inheritor of the hermeneutical-rhetorical tradition. But whereas the early Italian humanists attributed great importance to metaphorical image-making as the basis for *all* work, including the work performed in contact with nature, Vico's attention went mostly to phenomena such as histories and myths — interpreted as that which men had made themselves and, as was assumed, could therefore understand.

Vico's philosophy, the fifth important resumption of the tradition, represents a defence by the text-oriented culture of humanism, which was in the process of being overshadowed by the new experimental natural science. Pressed by the impression the latter made, Vico left the 'interpretation' of nature (created by God) to natural science — where the metaphor of the book of nature had become meaningless anyway. From the seventeenth century onwards, the interpretative hermeneutical-rhetorical tradition lived on only in the humanities, that is to say, in the area of text interpretation.

The line of hermeneutical development can be traced right up to our days. It runs from Vico to the pioneering thought of Nietzsche, the more traditional Wilhelm Dilthey, and via the latter to the founders of hermeneutical philosophy in our century, Heidegger and Gadamer. In this sixth (post-metaphysical) resumption by Heidegger and Gadamer text interpretation became again the epistemological model for the approach to nature and natural phenomena.[13] Contemporary hermeneutical philosophy speaks of human beings 'inhabiting' the world with care and understanding, practising an open, listening attitude to what presents itself.

As the act of interpreting a literary text is based on an attitude of *listening* to others, the tradition may once more offer the opportunity of envisioning *mutual interaction* and *respect* between human beings and the phenomena of nature. The metaphor of reading nature suggests that nature might somehow be meaningful and expressive and that just as a reader is required to respect the voice of the text, so human beings, including natural scientists, might respect the (voices of) nature they seek to understand.

[13] J. Figl (1982) interprets Nietzsche's philosophy of the will to power as a form of hermeneutical ontology. Wilson (1982) shows that in *Sein und Zeit* (1927) text interpretation is Heidegger's leading metaphor for man's relationship to Being. E. Jones (1989) draws attention to the importance of the philosophy of M.M. Merleau-Ponty for a hermeneutical approach to nature. In the context of this study I cannot delve deeper into the influence of the hermeneutical tradition upon these thinkers.

Before pursuing this analogy, however, I shall first pay attention to contemporary literary theory. I would like to chart the current opinion about what it is to read a text, in particular a literary text; what a literary text is, and what its effects on reader and text are.

6.3 CONTEMPORARY LITERARY THEORY

The self-appointed task of literary theory and the study of literature is analyzing texts belonging to the specific corpus of literature. Subjects of study include the relationship between literature and reality, the fictional nature of literary texts, the relationship between literature and society, literary techniques and stylistic devices, communication techniques.[14]

In Wolfgang Iser's *Die Appellstruktur der Texte* (1971) we read that a literary text neither provides an image of reality (objects, situations) nor creates it. Literary texts contain responses to what is experienced by author and readers as reality. The reality that is evoked in literature deals with elements which also play a role in common experience and thus enable people to recognize so much in literary writings. But the experiences people have of the world are put together in a different way by creative writers of literature: the presences they evoke transform a world that is seemingly familiar to us into a world deviating from what we are used to. According to Iser it is naive to assume that literary texts present an image of an actual reality: the reality of the text is first formed by that same text. The *poetic* image has *rhetorical* effect.

It is interesting to observe that the same to applies to innovative scientific texts as well, as we have seen in chapter four. An innovative scientific text, such as Darwin's *Origin of Species*, does not record a state of affairs. Like a literary work, it *does* something: it evokes a world, a world in which matters not previously qualified as such are acknowledged as 'facts'.

In the act of reading a literary text, to return to Iser, the text is in some way *actualized* by the reader. The meaning of a text cannot be detached from the act of reading: there is no such thing as 'the' meaning, to be approached more or less successfully in the different readings. The meaning of a literary text is established during the process of reading; it is the interactive product of text and reader, and

[14] J. van Luxemburg a.o. (1981).

not a given meaning, hidden in the text to be discovered by interpreters.

It is interesting indeed that this also holds for the reading of innovative scientific texts. The diverging interpretations sometimes given to scientific texts are symptomatic of a deeply rooted ambiguity in the text itself. Darwin's *Origin of Species*, for instance, has no fixed meaning or, to put it in another way: it has various possible meanings — hence its generating so many different interpretations and effects.

In literature, and especially in a poem, the multi-faceted meanings of the words, the sentences, and the poem as a whole is deliberately (sometimes unconsciously) built in by the poet.[15] Each new interpretation makes the previous ones a subject for discussion, lays them on the table, trespasses on them. Together they determine the beauty of the poem and give depth to the experience of the reader. However, the poem as an entity still evades us. Only our experience, our reading, our *interpretations* of it can complete the poem, make it 'live' or 'be'. As observed above, a scientific text is also that sort of text: the *Origin of Species*, to refer to it once more, is concretized in acts of reading, in diverse ways. The gap alleged to exist between literature and science seems to be closing.

The Aristotelian distinction between possibility (*dynamis*) and reality as energy (Gr.: *en-ergeia* — literally, to be in or at work) might be both useful and an impediment in understanding this interaction view of literary texts and their readers. Aristotelian *energeia* is an active and dynamic concept of being, being in the sense of functioning, of performing to capacity, of complete involvement (often expressed in teleological terms: being fully what something is meant to be). This distinction between possibility and actuality operates in a text, for instance a poem. A poem that is not read, we could say, is not wholly present, not *energeia*. The text would be wholly present, wholly itself, fully actualized, in the form of *energeia*, in acts of reading. But a poem in its capacity of available object could also be actualized in a different manner — for instance, as wrapping paper, as a gift, or as a fly-leaf in medieval writing. Even when the poem is fulfilling its poetic potential by being read, it is therefore never wholly present: for it can continually give rise to new interpretations and new effects. With reference to the ceaseless stream of interpretations that a text can foster in the interpreters' interaction with it, Gadamer speaks of the

[15] As U. Eco (1972) points out, a literary text leaves out much – this offering the readers the opportunity to make it concrete in various ways.

effective history (*Wirkungsgeschichte*) of a text.[16] Because a rich literary text is polysemous and inexhaustible in offering possibilities for new readings, full realization, or full *energeia,* is not possible. To ask what (or rather how) the poem in question is 'in and by itself' is to ask a wrong question. The question should be what the poem, being an open structure, *could* 'be', and that remains a matter of conjecture, of interpretation, of the readers' intercourse with it. In this sense it can be said that the reader 'makes' the text in responding to it. In this way the 'being' of a poem differs from what is suggested by the traditional static image of the being of a 'thing'. But it differs also from the traditional teleological Aristotelian view of a thing having a predetermined development from potency to act.[17] There is not *one* possible way of being for a poem, but *many.* In this respect the application of the Aristotelian notion of *dynamis* to a poem is an impediment to the understanding of its being a text.

Literary texts, like those we are familiar with in our culture, are networks of words, sentences and other larger items such as verses, sections, chapters, books. They are the result of conscious writing acts on the part of individual persons. And yet this does not mean that, for example, the literary authors create their texts in sovereign freedom. Authors represent crossroads, or transits, of social and cultural structures, of other texts and of language itself. Since the Renaissance period we have been persuaded that a text is the 'creation' of a literary writer, a genius acting in sovereign independence.[18] But the author's freedom is, in fact, limited: by the 'tongue' she speaks, by literary conventions, by her intended audience's capacity to understand and by genre structures.

Moreover, if it is not the sovereign selfconfident writer who makes a text into a true text but the act of reading, of interpreting, the concept of text can be broadened. In social and cultural life human beings are surrounded by artifacts of all kinds which can be compared to written texts — cities, landscapes, institutions, human actions.

Aristotle's philosophy of potency and act was born out of the desire for and belief in *one* possible realization, being an entity's perfection. By contrast, we no longer accept the idea of an eternal realm of perfect unchanging Being, and we therefore should no longer imagine

[16] H-G. Gadamer (1975, pp.282-290).

[17] See M. Heidegger (1950) and (1954). Also I. Prigogine criticizes the traditional concept of things in *La nouvelle alliance.*

[18] cf. M. Foucault (1980) and S. IJsseling (1981).

that there could be such a thing as *one* complete *energeia*, be it in an metaphysical Hegelian perspective of a world having reached its final destination, or an ontological perspective of each entity having only one way of being truly itself. To avoid such a deterministic ontology the contemporary view of literary texts as open structures that need the readers' help in reaching their potential (and that helps the readers in reading their potential) may be helpful. With the model of a literary text as an open structure that can be realized in many ways before us, and keeping in mind that artifacts can be considered 'text', I would like to present my sketch for a hermeneutical ontology.

6.4 SKETCH FOR A HERMENEUTICAL ONTOLOGY

Various authors in the contemporary hermeneutical-rhetorical tradition have extended the notion of text beyond human artifacts. Meaning is not only conveyed through written texts, and does not come about by the actions of authors — in a wide sense — alone. As Heidegger and Gadamer maintain, human beings always stand in a meaningful relation to cultural as well as natural reality. So we say that a poet, a philosopher, a social geographer, and a scientist 'interpret' the ocean or the skies. Configurations not brought about by human beings, such as nature untouched by human hands, can be said to have meaning, can be interpreted by human beings, and thus can metaphorically be said to be 'texts'. Seen from the perspectives of contemporary literary theory and twentieth-century hermeneutical philosophy, the expression 'language of nature' loses its antiquarian character.

Does the textual nature of reality result only from our interpretative approach to it? As the gap between literary and scientific texts originated in the separation between a supposedly external reality 'over there' and a realm of human affairs located 'here', I suggest that in answering this question we might explore the consequences that its closing might have for our view of reality. So far the conclusion usually has been that reality is somehow at the mercy of the discourses human beings happen to develop, *vide* Shapin and Shaffer's conclusion in *Leviathan and the air-pump* that Hobbes was right.[19] I wonder, in contrast, whether reality could be perhaps less exact, more 'ambiguous', expressive and open than was believed by modern scientists? Is ambiguity or *polysemy* perhaps not only a characteristic of literary texts,

[19] S. Shapin and S. Shaffer exemplify in this respect the point of view of constructivists in general.

but also of what we call nature, and could that be the reason for the hidden ambiguity or polysemy of scientific texts? In other words, could the latter be symptomatic for an ambiguity or polysemy of 'nature' herself, and *vice versa*? Would it make sense to develop the hermeneutical-rhetorical tradition into this direction? Could the metaphor of reality as a text again be made to 'work' by opening up reality?[20] This leads to one more question: would our interpretive freedom in 'reading' the 'text' of nature not make us responsible for our interpretations in a way that the scientist who supposedly merely 'mirrors' nature or 'constructs' her can never be?

An important argument for the ambiguity or polysemy of nature is the language of science itself. That reality was univocal was the creative vision of modern science. *This* reality is best expressed in exact and univocal language. But scientific language has never succeeded in being totally exact and univocal. Should this be interpreted as a *failure of language*, language always remaining 'hopelessly inexact' because it cannot shake off its ties to ordinary life? Or should the continued presence of literary elements in scientific texts be rather interpreted as a *symptom of an elusive nature* which can never be captured in exact language — a nature to which precisely the experience of ordinary people provide access?

Indeed, the literary elements in scientific texts betray human interests: they point to emotions, however hidden — for example, to love, fear, gratitude, a sense of beauty, a desire for control and mastery. They point, in other words, to *another nature* than the nature envisaged by modern science: a nature in which human beings recognize themselves, a nature in all respects *close to us*, an 'anthropomorphic' nature, we might say. The literary elements are symptomatic for the continuing presence of a nature which might also be envisaged this other way. To do justice to this latter possibility, to allow the presence of this other nature in our world, an entirely different — i.e. a literary — mode of expression is required.

[20] *In Philosophy and the mirror of nature* (1979), R. Rorty seems to connect modern science, language, and the ontology upon which modern science is based. The more we realize that people and things have no fixed essences, he states, the better we can accept the non-scientific representation of them, for example by writers, psycho-analysts and sculptors. The distinction between a fact to be described objectively and the subjective value judgement, was in the last resort, made to place these alternative ways of representation in a bad light, as though they were "merely non-cognitive ornamentation". R. Rorty (1980, p.362). In the end, however, Rorty is not interested in ontology. The essays on contingency (Rorty 1980) show that this neglect leads to a total lack of respect for nature.

The connection between the kind of tentative knowledge entailed by the logic of discovery and the tentative and imaginative metaphorical language in which this knowledge is articulated on the one hand, and ontological questions on the other, may be brought to mind by focusing on the relative freedom a scientist/author like Darwin had in *envisioning* the origin of species: freedom in selecting experiences, and in selecting metaphors to give these experiences extra dimensions, furthermore in combining the selected experiences to create new metaphors and experiential configurations (choice of breeder and combination of breeder and nature). This relative freedom might be positively valued as an *opportunity for creative interaction* in stead of deploring such freedom as the consequence of incomplete knowledge.

Since Kant, the freedom of the researcher to create theories has been assigned a negative value in philosophy in general, and in the philosophy of science in particular: this type of freedom has been associated with the lack of objectivity, with *subjectivity* of human knowledge. Kant pointed out the limitations of our understanding (knowledge is conditioned by time and space, by cultural and historical circumstances and by language) and of those stemming from our corporality (knowledge is conditioned by the senses, which can detect only certain phenomena in our field of observation). He suggested that only phenomenal reality — in his view being determined by the laws of Newtonian science — can only be known completely and exactly by science; we are incapable of knowing 'true' (noumenal) reality, which is known to God only. Vis à vis phenomenal reality the knowing mind was free *as long as* it did not completely know its objects of knowledge. In post-Kantian philosophy, the notion of a noumenal reality has been abandoned. G.F.W. Hegel, and later the positivists, maintained that in principle reality could be known completely and exactly. In this frame of thought the freedom of the researcher was also only temporary.

The freedom of the knowing mind has thus mostly been interpreted negatively as *lack of certainty and objectivity*. To those practising science, awareness of subjectivity has been counterbalanced by the hope that in the course of research, i.e. in the course of time, the subjective elements in knowledge would gradually correct one another, that human beings would finally attain certainty in knowing the 'objective reality' of nature — that in science freedom would disappear, or at least decrease. By and large, contemporary science has given up this hope: reality is too complex; it cannot be represented, in fact, it cannot

even be thought. The freedom of the scientist will remain — but this prospect is not applauded.

In the wake of the hermeneutical-rhetorical tradition as developed by Heidegger and Gadamer my suggestion is that the relative freedom of the researcher, when speaking of reality or nature, might be considered positively in envisioning the nature of the 'object' of study as polysemic, rich in possible meanings. I suggest an *ontological* interpretation of the fact that scientific language has 'still' not been purged of tentative metaphorical language and other literary elements (and, as Ingarden admits, never will be) and of the fact that hypotheses may always be falsified.

According to this view, 'reality' is not so much *known*, or logically *inferred*, as *interpreted* (and thereby *actualized*) in our dealings with it, for example, in scientific research.[21] While it is true to say that an interpretation is the work of a subject, a human being for instance, it does not lose its link with its *interpretandum*. An interpretation might be described as an inquiry by a subject into the *interpretandum's* possible meaning, and as a *translation* of what the interpreted entity — a text or a natural entity as a quasi-subject — says, a *speaking for* it. In other words: an interpretation might be described as a *representation* of this meaning in the political sense.[22] The hermeneutical-rhetorical position could thus be considered a moderate form of scientific realism holding on to the 'real existence' of the object of knowledge — but just as easily a moderate form of scientific anti-realism, acknowledging the impact of language on it. What 'reality' is thus becomes the result of 'negotiations' between the ('human') actors speaking verbal language and ('natural') actors 'expressing' themselves in very different ways. *Both* humans and nature have a share in 'world making'.

It should be remembered at this point that seeing or making a metaphorical link requires a creative use of language, to which some people are more sensitive, having a more intimate feeling for *language*. Making such links is not subjected to any fixed rules. The metaphor indicates and establishes in the medium of language a rapport which was, as it were, *potentially* there in nature — but, as I would suggest, potential in a non-linear, or non-Aristotelian manner. The potentiality involved in metaphorical speech permits a number of actualities. We

[21] In notes from his later period F.W. Nietzsche speaks of scientific research as a matter of interpretation and reading. For this see J. Figl (1982). See also P.A. Heelan (1983).

[22] See chapter five, § 1.5 of this study.

may conclude from this that, if an analogy between a literary text and nature (reality or being) could be accepted, the latter could be conceived of as a *state of possibilities* which could provide support for different interpretations, different ways of become expressed, different ways of being made concrete or real. This concept of being is different from Aristotle's concept of being as essence. It is also very different from the medieval concept of the world's being as *actualitas,* as it was understood by St. Thomas: being as God's (imperfectly) embodied creational Idea.

Hermeneutical ontology, as I see it, fosters an understanding of the reality of nature as a *possibility-state.* It belongs to a metaphysics that wants to be *pluralist.* Like poems, phenomena in nature, relatively stable as they are, have various ways-to-be, and *become* what we (*and* other beings and forces) *let* them *be* in our dealings with them, in our case notably in our language behaviour.

Living all our lives among inanimate objects, living creatures and people, we have various and constantly changing relations with them. Different aspects of these different relations present themselves, as it were, to us — aspects which are, again, expressed in different interpretations. In this sense we can say that inanimate objects too, like living entities and people, are like poems: they 'become' what they 'are' in the interactions with those who deal with them; that without this mutual relationship they are 'unfinished', and they will remain 'unfinished' in the relationship. In the different interpretations things 'are' (possibilities are made present) in different ways. Ontologically speaking, objects — let alone living entities and people — are not quite simply objects in the sense that they are ready-mades. This means also that the boundaries between 'nature' and 'culture' become fluent.[23]

Possible worlds would be realized (concretized or actualized, in short: made *real*) in (among other things) scientific research, just as — according to Iser — interpretations of a literary text actualize, or concretize, possible meanings of a text. The concretization of the 'text' of nature in the area of scientific research initially takes place via metaphors and images used by innovative scientists: the visions in

[23] K.D. Knorr-Cetina (1991) reaches the same conclusion, be it not from an ontological point of view. In the last chapter entitled 'Wissenschaft als interpretative Rationalität oder: Die Uebereinstimmung zwischen den Natur- und Sozialwissenschaften' ('Science as interpretative rationality or: The Similarity of the natural and human sciences') she advocates an interpretative model of natural science. cf. also P. Kockelkoren (1991A) for another kind of hermeneutical approach to nature.

which they put their conjectures of possible truth — including possible concrete reality — into words regarding the reality of nature.[24]

In this sense it can be said that the reality in which we live, including nature, is human-made. Different people and different scientists will choose different metaphors for the same area of reality. However, the insight into, or the conjecture about reality, expressed in a verbal statement is no pot shot, no arbitrary imagining: in natural science experiments indicate limits to what can be realized, like in interpreting a text there are limits to what can be read legitimately as its meaning(s). Nature 'talks back'. The experimental 'arguments' which support the insight guarantee that the insight is one (of several) truly possible forms of knowledge. Reality, including the reality we call nature, provides ground for more that one possible 'meaning'.

Hermeneutical ontology thus clarifies in what sense the reality in which we live may be called 'fantastic',[25] what exactly may be meant by the 'magic' of language,[26] how metaphors can be said to creatively mediate reality,[27] and how we may envisage the interaction between language and reality:[28] as a possibility-state, reality is *at the same time* objectively real *and* subjectively shaped, found *and* made.

Since many metaphors are possible, in and outside of science, and will always remain possible, they are of a transitory nature; it is precisely because no rules can be made for the process, that conceptions and concretizations of reality replace one another in the history of science and culture, in the course of time, and that they also change from culture to culture and from person to person.

Thus following the analogy between nature and text the possibility of several 'meanings' which can be realized in science leads to a 'reality' (including the reality of nature) that is acknowledged to be more ambiguous than Galileo and modern scientists thought. It leads to an elusive polysemic reality: not only because *we* are limited creatures, situated in the midst of reality and therefore unable to overview her objectively from above or from without, or because *our* language remains tired to our ordinary experiences, but rather because,

[24] cf. pp.85-90 of this study on Darwin's metaphors and their effects on our experience of the world.

[25] Ibid., p.69.

[26] Ibid., p.127.

[27] Ibid., p.90.

[28] Ibid., p.128.

as a possibility-state, *she* escapes us, and presents herself to us in unpredictable ways.[29]

What we observe is incomplete, an insight not unknown to the phenomenologist Edmund Husserl. Therefore our eyes and mind spontaneously fill in (a suggestion also made by cognitive psychologists) what cannot be seen as such; or, with the instrumentalists, we carry on with the construction of models and the stating of hypotheses and experiments in a process of informed guessing. However, if the world which we experience escapes us, if reality evades us, then as Robert D. Romanyshyn puts it in *Science as Metaphor*,[30] what actually appears to us is *allusion*. By their very nature, allusions are equivocal or polysemic, and can be interpreted in various ways.

Nature as a possibility-state may thus be compared to a totality of signs, or as a poetical-rhetorical text, as contemporary literary theorists conceive of it. What we call the reality of nature would appear *not* to resemble a text because of its having been written (created) 'at some time', 'by some one', but because nature *is never completely subsumed in the hic et nunc,* always *transcends the hic et nunc*. She can never be completely *made to be present* or actualized in our modes of expression and laboratory experiments — at no point in time, at no possible future date; in other words: never so fully *interpreted* by us as nature's readers as to leave nothing unsaid. Not all of what we call 'nature' can be 'exposed', 'expressed', 'translated', 'represented' in the sense the word has in science, not all of her so-called 'inside' can be made to appear in the so-called 'outside'; not everything can be brought to light, be made visible,[31] just as no poem can be completely paraphrased in any other words than those of the poem itself. In the readers' or audience's interactions with the phenomena of nature, nature remains in principle

[29] In this context we may think of the old adage 'nature loves to hide' (P. Renaud 1976). The notion of elusive nature has been very important to Nietzsche – his dictum that reality is will to power and nothing else is an attempt to articulate a concept of nature without fixed essences and eternally fixated laws. I would also like to draw the attention to the metaphysics of G.W. Leibnitz. Leibnitz distinguished degrees of possibility corresponding to objective propensities to exist. He put the probable on a par with the possible. To him the probable still meant 'worthy of approbation' by wise and intelligent persons. That means also that in pronouncing what is probable the character of the philosopher in question is still relevant. See on Leibnitz, possibility and probability: I. Hacking (1976).

[30] R.D. Romanyshyn (1982, p.174).

[31] Ibid., p.166.

inexpressible and incognizable, and not a slice of information with accidentally hidden structures or 'codes'.[32]

In the hermeneutical-rhetorical perspective the world as we know it, the world in which we live, is *an instance* of a greater whole of possibilities, which embraces both 'culture' and 'nature'. Interpretation in human beings implies the use of images and language. In our roles as readers of nature we realize, materialize, 'make present' or concrete in our images, verbal interpretations (theories) and experiments one or more possibilities offered to us by reality. In our (Western) dealings with nature — in our interpretations of nature — the main 'tools' we employ in making her present in our world are attitudes such as curiosity, courage, inventivity, methodical and systematic planning, scientific instruments, laboratories, factories, technology, discoveries and, finally, intellectual tools such as the notion of nature 'opposed' to 'culture'. The traditional compartmentalization of knowledge in 'science' and 'literature' in itself already implies an interpretation. *Our* reality has been given material form through and in the (productive) statement (or story) we have wished to impart in our response to her. But — and this is the crux of the matter — *that statement, this culture, this nature, this reality could also have been different; what we call 'reality' could have been actualized (made present) differently* — although there are limits to what can be made present.[33]

The literary elements, in particular the metaphors, found in innovative scientific texts might indicate the writers'/scientist's openness not only to language, but also to nature, to the wealth of possible interpretations of reality, to nature's polysemy and rhetoric.

Seen from this hermeneutical-rhetorical perspective nature will continue to remain susceptible to different interpretations, articulating different story lines — be they 'scientific', 'religious' or 'literary'. Hermeneutical ontology accounts for the fact that, despite all our technological developments, a variety of 'cultures', of 'told worlds', is likely to continue to exist; and that, whatever happens, 'history' will continue. The 'fact' that there are many cultures, and that there is history, is a result of the possibility-state of what we call reality.[34]

[32] In this respect hermeneutical ontology differs from N. Rescher's 'approximationalism' – a realism that views science not as describing reality but as estimating its character (N. Rescher 1987).

[33] cf. the metaphysics of Leibnitz, note 29 of this chapter. cf. also S.C. Pepper (1961) on the importance of world-hypotheses and root-metaphors for the emergence of cultures. cf. Th.S. Kuhn (1977, p.331) on the importance of values in science. cf. also I. Hacking (1987, p.146).

[34] cf. Ilse N. Bulhof (1980, p.194).

Hermeneutical ontology might do more justice to contemporary natural scientific research with its logic of discovery than the traditional interpretation of it as observing, seeing, and knowing of what is?.[35] Might it also do more justice to 'nature'?

Throughout this study it has been argued that the traditional rigorous separation between science and literature, based on the classical distinction between external nature and the realm of human affairs, and between knowledge and imagination, is untenable. It should be stressed, however, that hermeneutical ontology emphatically acknowledges that the freedom of human beings in general, and scientific researchers in particular, has *limits*, both material and immaterial. For one thing, their freedom is tied to the existing reality which is the point at which scientists start their research: reality as given in its materiality and as interpreted by contemporary linguistic and cultural conventions. Science in this hermeneutical-rhetorical view is therefore by no means 'the same' as what we, in our culture, call 'fiction'. Science is not poetry.[36] Poets and novelists are much freer in their use of imagination, they have more possibilities of summoning up worlds — and these worlds more often than not remain 'imaginary': not realized, concretized or 'made present'. Innovative scientific researchers are creative, but not in the way that poets and novelists are, but — if one wants an analogy — rather in the way of architects. In scientific research 'new', but nonetheless 'real' states of affairs are 'called into existence' — just as the buildings created by the architect are real. To think that scientific researchers are types of poets in the romantic tradition (even if it be granted that the knowledge of scientists contains elements of 'fantasy') would be a dangerous over-estimation of our

[35] cf. I. Prigogine and I. Stengers (1979); Ilse N. Bulhof (1986). I would like to formulate Th.S. Kuhn's view of the history of science as follows: at the transitional stage of revolutionary science the manner of seeing is not fixed, no theory imposes itself, what people want to see is often a question of choice, a choice that at the time cannot be made exclusively on scientific grounds. At this stage the world can be interpreted in two or more ways, rather as if it were a poem. Once the scientific revolution has passed, what was originally a creative vision is now a fixed view; which makes it a matter of simply seeing, a scientific observation, 'normal science'. In *The Essential Tension* (1977, p.263) Kuhn writes that the crisis caused by a scientific revolution has passed when "some particularly imaginative individual, or a group of them, waves a new fabric of laws, theories and concepts, one which can assimilate the previously incongruous experience and most or all of the previous assimilated experience as well. *This process of reconceptualization* (my *italics*) I have elsewhere labelled scientific revolution". The notion of reconceptualization enables the observer to see the anomalies which the old paradigm could not cope with in a new way.

[36] Above (p.128) I suggested that a new classification of texts might be made based on the extent to which a text wants to link up with 'reality'.

human creativity and of our capacity effortlessly and spontaneously to create real worlds, let alone worlds that are good, or at least better than the present world. It would be a dangerous under-estimation of the power of that which surrounds us.[37] Moreover, the equation of science with creative poetry indicates profound lack of respect for nature's individualities, as they are in this approach degraded to creatures of our making.

Perhaps a hermeneutical ontology such as presented here is also what the philosopher of science, Hacking, has in mind. In his view, modern science since the seventeenth century has been 'the interlocking' of representing nature in theories and intervening in nature by means of experiments.[38] Drawing the attention to the role of experiments in the natural sciences, Hacking is sensitive to the relative autonomy of nature. He reproaches the theory-oriented philosophy of science inspired by the work of Kuhn,[39] that it implicitly conceives of nature as passive and inert, as something of which the properties have to be discovered, the secrets revealed. When the role of experiments is given their due, he argues, the possibility of an interaction with a relative autonomous nature emerges. Hacking suggests a different reading of the events that make up the constructivist story of scientific praxis, the story told by Latour and Woolgar in *Laboratory Life* (1979). As he sees it, facts merely become facts because people make the rules of the game and decide what will count as facts. Their story of what went on in the laboratory could also be told in a different and 'completely non-constructivist' manner. The negotiations emphasized by Latour and Woolgar, in their 'anthropological' approach to laboratory research, can be understood as negotiations about fixating *one* possible description, corresponding with *one* set of criteria of judging the details of a given experiment. Such a description is a true description according to realist authors, in the sense that it is *not made* to be true. It excludes other possibilities, Hacking suggests, because it is incompatible with other descriptions using a different set of criteria. There is, he writes, not one true or correct description. There is no reason to presume that there would be one which is. The world in

[37] The appeal to an objectively existing order of creation as is frequent in the catholic theological and philosophical tradition, is also an attempt to set limits – moral limits – to human creative activities. With regard to the distinction between literature and science which I have discussed in this book, the only limit I envisage in this particular passage is that of the 'actual' in the sense of the 'material' or the 'real'.

[38] I. Hacking (1987, p.146).

[39] Th.S. Kuhn (1970, 1977). Kuhn considers scientific revolutions in the first place 'processes of reconceptualization'. See note 33 of this chapter.

which we live "does not fix which discoveries or inventions will have to be made (...). A science can develop along many tracks and can cause diverging phenomena to exist".[40] Such a metaphysical pluralism does not necessarily mean that everything goes, he continues, for in fact 'many experiments do not work'.[41] Metaphysical pluralism does not lead to relativism, but to a "pluralism of possible developments".[42]

In the perspective of hermeneutical ontology that I am trying to articulate, we, humans, are saddled with an enormous joint responsibility for what we make of nature and her language, for what we in our negotiations with nature and with each other acknowledge that nature is and might become. We become responsible for the choices we make in deciding which responses to give and which possibilities to develop, and in choosing the kind of knowledge we produce. We are inclined to think first of all of our responsibility toward *human* society. But hermeneutical ontology should make us also aware of our responsibility toward *nature*.

At this point we might take to heart that — as is stressed by Wayne C. Booth — reading has an important *ethical* dimension.[43] A text does not mean whatever may suit us best; on the contrary: a good interpretation attempts to do justice to the text, to interpret (translate) the text in such a way that *its* possibilities become present. Similarly, hermeneutical ontology might offer us the opportunity of building a *moral* element, an element of justice, into scientific research itself: in the process of articulating metaphors and in making our stories about the world and ourselves, a moral moment may be heeded, instead of regarding that moment as merely an affair of applying results already obtained. Metaphors, and the larger stories into which they fit, might be evaluated upon their ethical effects for the 'speech situation' as a whole: the interrelated worlds of human beings and nature. Here we begin to see in which way the reader's *hermeneutical* quest for finding the right interpretation on the one hand, and the speaker's *rhetorical* intention of producing the right effect on the other, could merge in science. Such a merger occasions a whole new range of reflections. Let me in concluding this chapter briefly indicate which perspectives might be opened up when the moral aspect of the hermeneutical enterprise is taken as seriously.

[40] I. Hacking (1989, p.21).
[41] Ibid.
[42] Ibid., p.22.
[43] cf. W.C. Booth (1988).

Scientific instruments and exact scientific language are relatively non-human, not to say *inhuman*, means by which we concretize nature's possibilities. More *human* and possibly more *humane* means are verbal metaphorical language connected with our common human experience and material tools that are, for example, designed to *cultivate* nature. Could metaphors, I wonder, be made to work in an ethically responsible way to benefit the world of human beings and of nature? Yes, as I would like to imagine, to fantasize, attention might be paid to the question: which rhetorical-poetical language and which stories might call forth 'the best' in human beings *and* nature.[44] A truly 'educational' language might be developed — a language that would *cultivate* nature, as tools might *cultivate* nature on the level of our material intercourse with nature. Should the possibility of such an interaction not mean that the boundaries between nature and culture, so strongly emphasized in the Enlightenment tradition, *ought* to become meaningless?[45]

[44] V. Hearne (1987).
[45] Ilse N. Bulhof (1990).

CHAPTER SEVEN

CONCLUSION AND POSTSCRIPT

7.1 CONCLUSION

The literary analysis of Darwin's *Origin of Species* has made us aware of the linguistically constructed aspects of scientific texts, scientific truths and scientific experience. Nature as Darwin conceived of her was both *found* — for he did not create 'natural selection' from nothing — and *made* — for 'natural selection' represented aspects that could only become visible in the mirror of Western European Victorian culture. In mirroring his own world Darwin's imaginative language blurrs what has been so sharply opposed in modern science: 'nature' and 'culture', the alien exterior and the familiar human world, outside and inside.

Darwin's imaginative language expresses the searching method of an experimental scientific praxis which proceeds to produce knowledge by envisioning hypotheses, articulating them in words and formulas, and testing them against reality; after having been presented to the scientific community the new objective knowledge is added to the existing body of scientifically established knowledge, serving as a basis for further research.

Discovering the literary aspects of Darwin's *Origin of Species* has led me to inquire about literary elements in other scientific texts as well. Recent research confirms my hunch that natural science texts in the 1990's are in principle no less rhetorical — successfully persuading its readers to believe that what is presented is purely descriptive of what went on in the laboratory, that these texts simply pass on information that directly flows from nature herself; and that they are no less poetical — expressive of a vision of reality.

In view of the massive evidence of the continued importance of language in scientific praxis it is amazing that its presence went unnoticed for so long. Did scientists consciously hide the traces reminding of the context of discovery — traces that would obviate the claim to scientific neutrality and objectivity? Does science in our culture represent the kind of demonic power that is sometimes graphically put before us in science fiction novels and movies? This is the impression one sometimes gets from studies telling us how science, in pretending to tell the truth, 'invented' that same truth.

An excursion into the history of science has shown a different picture. New views in late medieval theology and philosophy and new political contexts gave birth to a new philosophy, nominalism. In postulating an absolute separation between speaker and objects spoken about, nominalism drew the attention away from language in order to focus on a 'reality' — nature — that supposedly could be seen without the mediation of language. Modern natural science is the offspring of these theological and philosophical visions. If there is a fault, these are the places where it should be looked for.

This study, by contrast, is written in the hermeneutical-rhetorical tradition. It reaffirms the mediating role of language in science. Using Darwin's *Origin of Species* as an example I have shown how human interaction with the world can never be direct, how experience is always interpretative, always mediated by language, how language is always poetical and rhetorical. But I have stressed at the same time, that these features do not make language arbitrary and deceptive. Human knowledge is both found and made. Human beings listen, interpret and give form to a reality that exists as a polysemic possibility-state: like a literary text offering more than one possibility to actualize it.

The hermeneutical-rhetorical tradition makes us realize that the condition of all language, including scientific language, is the co-presence of speaker, text and audience; that unmediated truth, truth not accommodated to the audience's power to understand, can never be properly judged, validated as right, appropriated and become effective in the world; that it can simply never make its appearance into the human world — unless truth is smuggled in as a mere 'technical' result of research, an object that cannot be disputed, a fact that is what it is, apart from any audience, destined to become part of the sub-human basis of human life.

I have adduced also an important *moral* reason why the notion of a separated and unmediated truth should be rejected: in present conditions it prevents a humane approach to nature. After nominalism had undermined the originally Greek trust in Being as rationality, order, beauty itself, and with it the Christian belief in the relative goodness of creation, the 'naked nature' lying outside the world of man, can never be perceived as morally inspiring or 'persuasive' to moral action. Such a truth can only be morally neutral, or a-moral. We have seen how deeply nature's moral neutrality or amorality shocked Darwin. Such a nature absolves man from the duty of acting humanly — humanely — toward her. A hermeneutical-rhetorical approach to

nature, by contrast, may restore a listening attitude towards a nature considered again as a complex of self-expressive entities.

The decline of the rhetorical tradition in the modern period has reduced rhetoric to mere ornamental speech, often associated with outright deception. This development has had an unfortunate consequence for nature: it has turned the rediscovery of rhetorical elements in natural science texts and praxis into a process of debunking science, and this, in turn, has caused some scholars to advocate a turnover of science and its object of study, nature, to politics. In a culture bent upon making nature subservient to human ends it cannot be expected that this development would increase respect for nature.

Only when the language arts poetry and rhetoric are rediscovered as a viable *ars inveniendi*, a means to find knowledge, may the rediscovery of rhetorical elements in science be an opportunity to lead us back to a type of inquiry which recognizes the knower's epistemic responsibility.[1] Such a discovery of the validity of rhetorical truth-finding should not only imply that the *human* community (scientific and other) should validate the proposed truth as the right knowledge for the context in which it will have to find a place. It should mean also that *nature*, now banished outside the human world as stupid, mute and subhuman and required to play a role as a mere background or substratum, should be allowed to re-enter that world — as a realm of fellow citizens, so to speak.

A renewed awareness of the role played by language in science, and attention to the relative freedom the scientist has in creating images and metaphors could contribute to freeing us from the scientific dogmatism still prevailing in many quarters, as well as from irresponsible glorification of the power of humans and their right to rule the world. It could lead to a more enriching experience of the world within and around us: to a new openness and respect towards what we regard as reality. In this context I have advocated conceiving reality as a possibility-state analogous to a literary text. This would create the opportunity to allow another nature to enter our present world than the exact and uniform nature envisaged by modern science; it would enable us to recognize a nature close to us in all respects — not only in theory but also in the actual practice of our personal and

[1] This term is introduced by L. Code (1987).

social lives. This will require a more literary language to express nature.

But *expressing* a nature that is not kept at a distance from us is not the same as *communicating* with her, or engaging in *mutual interaction.* To explore modes of genuine interaction might be a next step in reconsidering the relationship between culture and nature. The task I have assigned to myself in this study has been to exploit the language of science — so much more poetical and rhetorical than expected — as a first step. A question that might be explored in thinking through hermeneutical ontology is whether expressions such as 'elusive reality', 'receding horizon of science', 'reality as possibility-state' and the 'self-expressive' quality inherent in natural things might possibly be different ways of articulating a same intuition. From their creative use of language, it would seem that innovative researchers are the very people to suspect the existence of a reality richer than that in which we are led to believe by the dictum of a language that is exact, prosaic, unambiguous, and technical, while they at the same time realize the limitations to what humans can do. Darwin has served as an impressive example.

7.2 POSTSCRIPT

The exact language of the natural sciences has had a spellbinding effect on modern culture: the energy radiated by it was so great that people unconnected with natural scientific research have been deeply affected. Almost everyone who was not a literary writer began to aspire to the scientific style of speech and thought. Almost everyone began to believe in the super-object that this language had conjured up — unequivocal, predictable, calculable, manipulable nature. Thus the language of science was able — to use the expression of Max Weber — to disenchant the world. Perhaps this has been the strongest expression of its power: that it succeeded in inspiring the belief that, being one and unequivocal, there is basically nothing mysterious about this world; that whatever evokes wonder in nature — the wonderfully beautiful, good, horrible or frightening — is no more than a problem that we have not yet succeeded in solving.

But meanwhile the question of language in science is being reexamined in several quarters. And other kinds of physics have taken over from the classical natural sciences: quantum physics, the physics of Ilya Prigogine and contemporary astronomy are examples. Here the division between subject and object and the dualism of matter and spirit are disappearing. Things are spoken of as events, nature's

expressivity is being recognized, and boundaries between nature and culture become flexible again. Many philosophers — feminists, philosophers of science, philosophers interested in metaphysics and in language — are taking similar directions. Feminist philosophers are very much interested in the issue of nature. Here we might think, for example, of Evelyn Fox Keller, who in *Reflections of Gender and Science* (1985) advocates a listening attitude in natural science research. Ecologist philosophers such as Petran Kockelkoren plead for respect of the integrity of nature's individualities *vide* his article on a hermeneutical approach to nature in which vulnerability and embodiment are the main vehicles for nature's expressivity (1991A). Böhme finds aspects of the long despised Renaissance approach to nature inspiring. Barbara Noske in *Humans and other animals* (1989) advocates a 're-subjectification' of animals. Furthermore, pointers for the development of a rhetorical language in our dealings with nature may be found in Vicky Hearne's *Adam's Task. Calling Animals by Name* (1986). Special mention should be made in this context of the work of the 'philosophers of experiment'. In the preceding chapter I have quoted extensively from one of them, Hacking. In a challenging manner, the philosopher of science Latour is moving into the direction of a new ontology. Latour pleads for attention for the ontological status of the new 'things', or quasi-objects as he calls them, which have been discovered or constructed by science such as the microbes discovered by Pasteur. Are they nature, are they culture, something in between, or does traditional ontology fail to account for such entities? In the context of these developments it is significant that Paul Ricoeur, well-known for his work on narratology, indicates contours for a new departure in ontology at the end of his *Soi-même comme un autre* (1990).

The explorations of these many new avenues in our thinking about nature and culture, together with the renewed study of scientific texts, may lead ultimately toward a profound revision of the relationship between 'reality' and 'fiction' (or imagination), between object and subject, and science and literature — in short toward a new organization of knowledge reflecting a new experience of reality. Perhaps the human knowledge (insights) that is nowadays stowed away in literature and the other arts, in religions and world views, may be reintegrated in new ways of truth finding. Rorty in his latest book,

Contingency, irony and solidarity (1989), is already offering some interesting suggestions for such a reintegration.[2]

These developments have as yet hardly penetrated our culture as a whole, not only because people are unaware of this kind of specialized activity, but also because there is reason for some caution as far as *some* forms of post-metaphysical philosophy are concerned: they may bring in the Trojan horse of despotism.

Merely to spoil the game that scientific language plays with us, does not suffice. I advocate directing our energies towards ways of thinking which, from the very outset, may move us toward a more modest and respectful attitude toward 'nature' or 'reality' and may give the ethical dimension of scientific thought another chance. Rethinking language, ontology and the audience's role in validating knowledge are some of the major avenues to be explored.

[2] Yet, with his rejection of philosophy as we have come to know it in our culture, including the enterprise called ontology and the notion of truth, he is paradigmatic for the type of reasoning that relies exclusively on the perspective of language.

BIBLIOGRAPHY

PHILOSOPHY AND PHILOSOPHY OF SCIENCE

Bachelard, G., *La formation de l'esprit scientifique, Contribution à une psychanalyse de la conaissance objective.* (Paris 1980), Librairie Philosophique J. Vrin (first edition 1938).

Bacon, F., *The new organon.* F.H. Anderson (ed.), (Indianapolis/ New York 1960), The Bobbs-Merrill Company, Inc.

——, *The advancement of learning.* G.W. Kitchin (ed.). Introduced by Arthur Johnston, (London 1973), J.M. Dent and Sons Ltd (first edition 1605).

Bloor, D., *Knowledge and Social Imagery.* (London 1976), Henley and Boston, Routledge and Kegan Paul.

Blumenberg, H., *Die Lesbarkeit der Welt.* (Frankfurt am Main 1981), Suhrkamp Verlag.

Böhler, D., *"Naturverstehen und Sinnverstehen. Traditionskritische Thesen zur Entwicklung und zur konstruktivischtisch-szientistischen Umdeutung des Topos vom Buch der Natur"*, in: Friedrich Rapp (Hrsg.). Naturverständnis und Naturbeherschung. Philosophiegeschichtliche Entwicklung und gegenwärtiger Kontext, (München 1981), Wilhelm Fink Verlag, pp.70–95.

Böhme, H. and G., *Das Andere der Vernunft.* Zur Entwicklung von Rationalitätsstrukturen am Beispiel Kants. (Frankfurt aM. 1983) Suhrkamp Verlag.

Bouwsma, O.K., *"De termen van de gewone taal zijn..."*, in: Wijsgerig Perspectief op Maatschappij en Wetenschap, 26 (1985–1986), pp.198–201. Originally published in *Philosophical Essays* (Lincoln/ Nebraska 1965), University of Nebraska Press.

Boyd, R., *"Metaphor and theory-change: what is metaphor a metaphor for?"*, in: A. Orthony, Metaphor and Thought, (Cambridge/ London/ New York/ Melbourne 1979), Cambridge University Press, pp.356–408.

Bulhof, Ilse N., *"Experiencing Nature"*, in: Diogenes. An International Review of Philosophy and Humanistic Studies, 81 (1973), pp.26–43.

——, *"The Netherlands"*, in: Th.F. Glick (ed.). The comparative reception of Darwinism, (Austin, Tex./ London 1974), The University of Texas Press, pp.269–307.

——, *Wilhelm Dilthey. A hermeneutic approach to the study of history and culture.* (The Hague/ Boston/ London 1980), Martinus Nijhoff Publishers.

——, *"Psychoanalysis in The Netherlands."*, in: Comparative Studies in Society and History. An International Quarterly, 24 (1982), Special Issue, pp.572–586

——, *Freud en Nederland. De interpretatie en invloed van zijn ideeën.* (Baarn 1983), Ambo.

——, *"Geschiedenis – verhaal of wetenschap?"*, in: Taal en Geschiedenis, (Groningen 1984)A, Stichting Groniek, pp.76–93.

——, *"Persoonlijke weerbaarheid als psychotherapeutisch doel in een post-moderne maatschappij"*, in: Psychotherapie na 2000. Nederlandse Vereniging voor Psychiatrie, reeks 7 (1984)B.

——, *"Literarische Elemente in wissenschaftlichen Texten. Grundlegung einer hermeneutischen Ontologie"*, in: Philosophische Zeitschrift (1987), pp.35–53.

——, *"Frivole kunst, serieuze wetenschap"*, in: Wetenschap en Samenleving (1988)2, pp.17–26.

——, *"Metaphors and praxis: Reading the book of nature, creating new worlds and the ethical implications of knowledge"*, in: "Revue Belge de Philologie et d'Histoire", in print (1990).

Canguilhem, G., *"La théorie cellulaire (1945)"*, in: La connaissance de la vie, (Paris 1975), Librairie Philosophique J. Vrin.

Carré, M.H., *Realists and Nominalists.* (Oxford 1946), Clarendon Press.

Code,L., *Epistemic responsibility.* (Hannover and London 1987), Brown University Press, University Press of New England.

Descartes, R., *Meditations on first philosphy*. Translated with an introduction by L.J. Lafleur, (Indianapolis/ New York 1960), The Bobbs-Merrill Company, Inc.
——, *Discours de la methode, suivi des Méditations, présentation et annotation par Francois Mizrachi*. (Paris s.a.), Union Generale d'Editions (1637).
Dockhorn, A.K., "Hans-Georg Gadamer's *Truth and Method*", in: *Philosophy and Rhetoric*, 13 (1980), pp.160-180.
Duintjer, O., *"Produceren en andere wijzen van mens-zijn"*, in: Tijdschrift voor Filosofie, 45 (1983), pp.421-459.
Eeden, F. van, *Dagboek, 1878-1923*, vier delen. Voor het Frederik van Eeden genootschap uitgegeven en toegelicht door H.W. van Tricht. Met een register door H. van Eeden, (Culemborg 1971), Tjeenk Willink-Noordrijn.
Feyerabend, P., *Against method. Outline of an anarchistic theory of knowledge*. (London 1979), Redwood Burn Limited Throwbridge and Esther (first edition 1975).
Figl, J., *Interpretation als philosphisches Prinzip*. (Berlin/ New York 1982), Walter de Gruyter.
Foucault, M., *The order of things. An archaeology of the human sciences*. (New York 1973), Vintage Books. Translation of: Les mots et les choses (1966).
——, *"What is an author?"*, in: Language, counter-memory, practice. Selected essays and interviews (1980). Edited, with an introduction, by D.F. Bouchard, pp.113-138 (French text 1969).
——, *M. Foucault – excerpten en kritieken*. M. Lambrechts (red.), (Nijmegen 1982), Socialistische Uitgeverij Nijmegen.
——, *"Ervaring en waarheid, Duccio Trombadori in gesprek met Michel Foucault"*, in: Te Elfder Ure (1985).
Freud, S., *Civilization and its discontents*. Newly translated from German and edited by J. Strachey, (New York 1962), W.W. Norton and Company, Inc. Translation of: Das Unbehagen in der Kultur (1930).
Gadamer, H-G., *Wahrheit und Methode. Grundzüge einer philosphischen Hermeneutik*. (Tübingen 1975), J.C.B. Mohr (Paul Siebeck) (1960).
——, *Rhetorik und Hermeneutik*. Als öffentlicher Vortrag der Jungius-Gesellschaft der Wissenschaften gehalten am 22.6.1976 in Hamburg (Göttingen 1976), Vandenhoeck und Ruprecht.
Galileo, G., *Discoveries and opinions of Galileo*. Translated with an introduction and notes by S. Drake, (Garden City, N.Y. 1957), Doubleday and Company.
Golinski, J.V., *"Robert Boyle: scepticism and authority in seventeenth-century chemical discourse"*, in: The figural and the literal. Problems of language in the history of science, 1630-1800, Andrew E. Benjamin, Geoffrey N. Cantor, and John R.R. Christie (eds.), (Manchester 1987), Manchester university Press.
Goodfield, J., *An Imagined world. A Story of Scientific Discovery*. (New York 1984), Harper and Row Publishers.
Goodman, N., *Of other minds and other matters*. (Cambridge/ London 1984), Harvard University Press.
Grassi, E., *Macht des Bildes: Ohnmacht der rationalen Sprache. Zur Rettung des Rhetorischen*. (Köln 1970), M. Dumont.
——, *Die Macht der Phantasie. Zur Geschichte abendländischen Denkens*. (Königstein/ Ts 1979), Athenäum Verlag GmbH.
——, *Rhetoric as philosphy. The humanist tradition*. University Park (etc.), Pennsylvania State University Press (1980).
——, *"Humanistic rhetorical philosophizing. Giovanni Pontano's theory of the unity of poetry, rhetoric and history"*, in: Philosophy and Rhetoric, 17 (1984), pp.135-155.
Gusfield, J., *"The literary rhetoric of science: comedy and pathos in drinking driver research"*, in: American Sociological Review, 41 (1976), pp.16-34.
Habermas, J., *Der philosophische Diskurs der Moderne*. Zwölf Vorlesungen, (Frankfurt am Main 1985), Suhrkamp Verlag.
——, *Erkenntnis und Interesse*. (Frankfurt am Main 1968), Suhrkamp Verlag.

Hacking, I., *The emergence of probability. A philosophical study of early ideas about probability, induction and statistical inference.* (Cambridge 1978), Cambridge University Press.

——, *Representing and intervening: introductory topics in the philosophy of natural science.* (Cambridge/ New York/ New Rochelle/ Melbourne/ Sydney 1987), Cambridge University Press (first edition 1983).

——, *"Filosofen van het experiment"*, in: Kennis en Methode, 13 (1989)1, pp.11-27.

Hearne, V., *Adam's Task. Calling Animals by Name.* (London 1986), William Heinemann Ltd.

Heelan, P.A., *"Perception as a hermeneutical act"*, in: The Review of Metaphysics, 145 (1983), pp.61-77.

Heidegger, M., *"Der Ursprung des Kunstwerkes"*, in: Holzwege, (Frankfurt am Main 1950), Vittorio Klostermann, pp.7-69.

——, *"Das Ding"*, in: Vorträge und Aufsätze, (Frankfurt am Main 1954), Vittorio Klostermann, pp.163-185.

Heilbroner, R.L., *"The murky economists"*, in: New York Review of Books, April 24 (1986), pp.46-48.

Hoeven, P. van der, *Galileo.* (Baarn 1966), Wereldvenster.

Husserl, E., *Over de oorsprong van de meetkunde.* Vertaald door dr J. Duytschaever. Ingeleid en geannoteerd door dr R. Boehm, (Baarn 1977), Wereldvenster (written in 1936; first edition 1954).

——, *Filosofie als strenge wetenschap.* Vertaling en samenvatting van G. Groot. Inleiding en aantekeningen van Th. de Boer, (Amsterdam/ Meppel 1980), Boom (eerste Duitse uitgave 1911).

Jones, E., *Reading the book of nature. A phenomenological study of creative expression in science and painting.* (Athens 1989), Ohio University Press.

Jordanova, L.J.(ed.), *Languages of Nature. Critical Essays on Science and Literature.* (London 1986), Free Association Books.

——, *Sexual Visions. Images of Gender in Science and Medicine between the Eighteenth and Twentieth Centuries.* (Hemel Hempstead 1989), Simon and Schuster International Group.

Keller, E. Fox, *Reflections on Gender and Science.* (Yale 1985), Yale University Press.

Knorr-Cetina, K.D., *"The Scientist as an analogical reasoner: A critique of the metaphor theory of innovation"*, in: The social process of scientific investigation. Edited by Karin D. Knorr, Roger Krohn and Richard Whitley (1981).

——, *Die Fabrikation von Erkenntnis, Zur Anthropologie der Naturwissenschaft, mit einem Vorwort von Rom Harré.* (Frankfurt 1991), Suhrkampf Taschenbuch Wissenschaft.

Kockelkoren, P., "De muis in de klauwen van de kat: een kader voor een hermeneutiek van de natuur", in: Wim Zweers (red.): "Op zoek naar een ecologische cultuur, milieufilosofie in de jaren negentig", (Baarn, Ambo 1991)A, pp.97-111.

——, "De betekenis van het landschap in postmoderne tijden", in: Jeroen van Westen (red.), "Bibliotheca Hermetica - essays over kunst en natuur", uitgave van de Rijks Geologische Dienst, (Heerlen 1991)B, Geologisch Museum Heerlen. pp.40-53.

Koningsveld, H., *Het verschijnsel wetenschap. Een inleiding tot de wetenschapsfilosofie.* (Amsterdam/ Meppel 1976), (Boom).

Kuhn, Th.S., *The Copernican revolution.* (Cambridge, Mass. 1957), Harvard University Press.

——, *The structure of scientific revolutions.* Second edition, enlarged, (Chicago 1970), University of Chicago Press (first edition 1962).

——, *The essential tension. Selected studies in scientific tradition and change.* (Chicago 1977), University of Chicago, Press.

——, *"Metaphor in science"*, in: A. Orthony (ed.). Metaphor and thought, (Cambridge/ London/ New York / Melbourne 1979), Cambridge University Press, pp.409-419.

Latour, B. and S. Woolgar, *Laboratory life: The social construction of scientific facts.* Introduction by Jonas Salk, (Beverly Hills/ London 1979), Sage Publications.

——, *"Postmodern? No, simply amodern – Steps toward an anthropology of science. An essay-review"*, in: Studies in the History and Philosophy of Science, 21 (1990), pp.145–171. (Dutch translation in Krisis, 10 (1990)2, pp.54–73).

——, *"Na de sociale wending het roer nogmaals om"*, in: Kennis en Methode. Tijdschrift voor Wetenschapsfilosofie en Wetenschapsonderzoek, 15 (1991), pp.11–37

Lepenies, W., *Das Ende der naturgeschichte. Wandel kultureller Selbstverständigkeiten in den Wissenschaften des 18. und 19. Jahrhunderts.* (München 1976), Carl Hanser Verlag.

——, *Between Literature and Science: the Rise of Sociology*, (Cambridge/ New York/ New Rochelle/ Melbourne/ Sidney 1988).

Manschot, H.A.M., *Althusser en het marxisme.* (Nijmegen 1980), Socialistische Uitgeverij Nijmegen.

Marcus, G., *"Why is there no hermeneutics of natural sciences? Some preliminary theses"*, in: Science in Context, 1 (1987)1, pp.5–51.

Merchant, C., *The Death of nature women, Ecology and the Scientific Revolution.* (New York 1980), Harper and Row, Publishers, Inc.

Miller, A.I., *Imagery in Scientific Thought. Creating 20th-Century Physics.* (Boston/ Basel/ Stuttgart 1984), Brinkhäuser Boston Inc.

Moody, E., *"Empiricism and Metaphysics in Medieval Philosophy"*, in: Philosophical Review (1958), pp.145–163.

Nauta, L.W., *"Achtergronden van het internalisme-externalisme debat – overwegingen bij een themanummer"*, in: Kennis en Methode, Tijdschrift voor Wetenschapsfilosofie en Methodologie, 3 (1979), pp.4–13.

Nickles, Th., *"Introductory essay"*, in: Th. Nickles (ed.). Scientific discovery, logic, and rationality. With a critical introduction by Thomas Nickles, (Dordrecht/ London 1980), D. Reidel Publishing Company.

Nietzsche, F.W., *"Jenseits Gut und Böse"*, in: K. Schlechta (Hrsg.). Werke in drei Bänden. (München 1965)A, Carl Hanser Verlag, teil 2, pp.562–761.

——, *"Über Wahrheit und Lüge im aussermoralischen Sinne"*, in: K. Schlechta (Hrsg.). Werke in drei Bänden, (München 1965)B, Carl Hanser Verlag, teil 3, pp.309–323.

Noordenbosch, O., *Het atheïsme in de negentiende eeuw.* Een critisch overzicht, (Rotterdam 1931), W.L. en J. Brusse.

Noske, B., *Animals and other humans.* (London 1989), Pluto Press.

Orthony, A. (ed.), *Metaphor and thought.* (Cambridge/ London/ New York/ Melbourne 1979), Cambridge University Press, pp.356–408.

Oberman, H., *Gabriel Biel and Late Medieval Nominalism*, Grand Rapids, (Michigan 1967), William B. Eerdmans Publishing Company.

Pepper, S.C., *World-hypotheses.* A study in evidence, (Berkeley 1961), University of California Press (first edition 1942).

Peursen, C.A.van, *"Ars Inveniendi" by Francis Bacon*, in: Tijdschrift voor Filosofie 51 (1989)3, pp.486–516.

Popper, K.R., *The logic of scientific discovery.* (London 1959), Hutchinson.

——, *Conjectures and refutations. The growth of scientific knowledge.* (London 1963), Routledge and Kegan Paul.

——, *"Epistemology without a knowing subject. An evolutionary approach"*, in: K.R. Popper, Objectivity and scientific understanding, (Oxford 1975), Clarendon Press, pp.106–152.

Prigogine, I. and I. Stengers, *La nouvelle alliance. Métamorphose de la science.* (Paris 1979), Editions Gallimard.

Radder, H., *De materiële realizering van wetenschap. Een filosofische visie op de experimentele natuurwetenschappen, ontwikkeld in discussie met Habermas.* (Amsterdam 1984), Vrije Universiteit Uitgeverij.

Renaud, P., *"La nature aime à se cacher"*, in: Revue de Métaphysique et de Morale, 81 (1976), pp.62–111.

Rescher, N., *Scientific realism: A critical reappraisal.* (Dordrecht/ Boston/ Lancaster/ Tokyo 1987), D. Reidel Publishing Company.

Ricoeur, P., *Soi-même comme un autre.* (Paris 1990), Editions du Seuil.

Romanyshyn, R.D., *Psychological life. From science to metaphor.* Foreword by J.H. van den Berg, (Austin, Tex. 1982), The University of Texas Press.
——, *Technology as symptom and dream.* (London and New York 1989), Routledge.
Rorty, R., *Philosophy and the mirror of nature.* Second edition with corrections, (Princeton, N.J. 1980), Princeton University Press (first edition 1979).
Russelman, G.H.E., *Van James Watt tot Sigmund Freud. De opkomst van het stuwmodel van de zelfexpressie.* (Deventer 1983), Van Loghum Slaterus.
Schuyt, C.J.M., *Ongeregeld heden.* (Alphen aan den Rijn 1982), Samsom Uitgeverij.
Shapin, S., *"Pump and circumstance: Robert Boyle's literary technology"*, in: Social Studies of Science, 14 (1984), pp.481-520.
——, *"Robert Boyle and mathematics: Reality, representation, and experimental practice"* in: Science in Context, 2 (1988)1, pp.32-58.
Shapin, S. and S. Shaffer, *Leviathan and the air-pump. Hobbes, Boyle, and the experimental life*, (Princeton 1985), Princeton University Press.
Sprat, Th., *History of the Royal Society.* (St. Louis 1959), Washington University Studies/ London, Routledge and Kegan Paul.
Turner, F.M., *Between science and religion. The reaction to scientific naturalism in late Victorian England.* (New haven/ London 1974), Yale University.
Vries, G. de, *Feitelijke expansionisme, een restrictionistische visie*, in: *Kennis en methode*,14 (1990)1, pp.44-59.
Vroon, P. and D. Draaisma, *De mens als metafoor. Over vergelijkingen van mens en machine in filosofie en psychologie.* (Baarn 1985), Ambo.
Weinberg, J.R., *A Short History of Medieval Philosophy.* (Princeton 1964), Prinseton University Press.
Weizsäcker, C.F. von, *Die Einheit der Natur.* (München 1979), Carl Hanser Verlag.
White, H., *Metahistory. The historical imagination in nineteenth century Europe.* (Baltimore/ London 1973), The Johns Hopkins University Press.
Wilson, *Sein als Text: Von Textmodell als Martin Heideggers Denkmodell: eine funktionalistische Interpretation.* (Freiburg 1982), Alber Verlag.

DARWIN AND DARWINISM

Bayertz, K., *Wissenschaft als historischer Prozess.* Die antipositivistische Wende in der Wissenschaftstheorie, (München 1980), Wilhelm Fink Verlag.
——, *"Darwinismus als Ideologie"*, in: Studien zur Dialektik, 5 (1982), pp.105-127.
——, *"Darwinism and scientific freedom. Political aspects of the reception of Darwinism in Germany 1863-1878"*, in : Scientia, 77 (1983)A, pp.297-307.
——, *"Darwinismus als Weltanschauung"*, in: Theoretische Geschiedenis, 10 (1983)B, pp.131-147.
——, *"Spreading the spirit of science . Social determinants of the popularization of science in nineteenth century Germany"*, in: Expository Science: Forms and Functions of Popularization. Sociology of the Sciences, 9 (1985)A, pp.209-227.
——, *"Zur Funktion analogischer Argumente in der Wissenschaft: das Züchtungsproblem in der Evolutionstheorie Darwins"*, in: Organismus und Selektionsprobleme der Evolutionsbiologie, 17 (1985)B, Arbeitsgespräch zu Fragen der Phylogenetik und Systematik in der Aussenstelle Lochmühle, 25-27 März 1983, Frankfurt am Main, Verlag Waldemar Kramer, pp.23-27.
——, *Darwin und die Evolutionstheorie.* Dialektik. Beiträge zu Philosophie und Wissenschaften, 5 (s.a.), Kurt Bayertz, Bernhard Heidtmann, Hans-Jorg Rheinberger (Hrsg.).
Beer, G., *"The language of discovery"*, in: Times Literary Supplement, November 2 (1984), p.12.
——, *Darwin's plots. Evolutionary narrative in Darwin, George Eliot and nineteenth century fiction.* (London 1985), Arc Paperbacks (Routledge and Kegan Paul, 1983).

——, *"The Face of Nature": Anthropomorphic Elements in the Language of the Origin of Species*, in: "Languages of nature, Critical Essays on Science and Literature", L.J. Jordanova (ed.), (London 1986), Free Association Books.

Berg, J.H. van den, *Koude rillingen over de rug van Charles Darwin. Metabletisch onderzoek naar onze verknochtheid aan de afstammingsleer.* (Nijkerk 1984), G.F. Callenbach.

Betz, H.J., *"Een nieuw boek tegen het Darwinisme"*, in: De Levensbode, 7 (1874), pp.286-428.

Burrow, J.W., *Evolution and Society. A Study in Victorian Social Theory.* (Cambridge 1970).

Campbell, J.A., *"Charles Darwin: rhetorician of science"*, in: J.R. Nelson, e.a. (red). The rhetoric of the human sciences, (Madison, Wisconsin 1987), University of Wisconsin Press.

——, *"The invisible rhetorician: Charles Darwin's third party strategy"*, in: Rhetorica: a journal of the history of rhetoric, 7 (1989)1, pp.55-85.

Darwin, Ch., *On the origin of species by means of natural selection or the preservation of favoured races in the struggle for life.* Introduction by Sir Julian Huxley, (New York/ Scarborough/ Ontario 1958)A, New American Library.

——, *The autobiography of Charles Darwin 1809-1882.* With the original omissions restored. Edited with appendix and notes by his granddaughter Nora Barlow, (London 1958)B, Collins.

——, *The autobiography of Charles Darwin, and selected letters.* Francis Darwin (ed.), (New York 1958)C, Dover Publications (first edition 1892).

——, *Charles Darwin, On the origin of species.* A variorum text. Morse Peckham (ed.), (Philadelphia 1959), University of Pennsylvania Press.

——, *On the origin of species.* A facsimile of the first edition. With an introduction by Ernst Mayr, (Cambridge, Mass./ London 1964), Harvard University Press.

——, *Early writings of Charles Darwin. Metaphysics, materialism, and the evolution of mind.* With a commentary by Howard E. Gruber. Transcribed and annotated by Paul H. Barret, (Chicago 1974), The University of Chicago Press.

——, *Darwin und die Evolutionstheorie.* Kurt Bayertz, Bernard Heidtmann, Hans-Jorg Rheinberger (Hrsg.). Dialektik. Beiträge zu Philosophie und Wissenschaften, 5 (s.a.).

Donders, F.C., *De harmonie van het dierlijk leven. De openbaring van wetten.* (Utrecht 1848), C. van der Post.

Eiseley, L., *Darwin's century. Evolution and the men who discovered it.* (Garden City, N.Y. 1961), Anchor Books (first edition 1958).

——, *The firmament of time.* (New York 1970), Atheneum.

Eng, E., *"The confrontation between reason and imagination. The example of Darwin"*, in: Diogenes. An International Review of Philosophy and Humanistic Studies, 95 (1976).

——, *"Thomas Henry Huxley's understanding of Evolution"*, in: History of Science, XVI (1978), pp.291-303.

Gilson, E., *D'Aristote à Darwin et retour. Essais sur quelques constantes de la biophilosophie.* (Paris 1971), Librairie Philosophique J. Vrin.

Glick, Th.F. (ed.), *The comparative reception of Darwinism.* (Austin, Tex./ London 1974), The university of Texas Press.

Harting, P., *Het microscoop: deszelfs gebruik, geschiedenis en tegenwoordige toestand.* (Tiel 1848-1854), H.C.A. Champagne.

——, *De voorwereldlijke scheppingen, vergeleken met de tegenwoordige.* (Tiel 1857), H.C.A. Champagne.

——, *Mijne herinneringen.* Amsterdam, N.V. Noordhollandsche Uitgeversmaatschappij (1861).

——, *Leerboek der dierkunde in haren gehelen omvang, vijf delen.* (Tiel 1862-1864), H.C.A. Champagne.

——, *"Iets over materialisme en materialisten, in verband met opvoeding en onderwijs"*, in: Album der Natuur (1869), pp.129-150.

——, *De strijd des levens.* Rede gehouden op 26 september 1870. (Utrecht 1870), J. Greven.

——, *Ernstige woorden tot zijne landgenoten.* (Amersfoort 1885), A.M. Slothouwer.
Hegeman, J.G., *"Darwin en onze voorouders. Nederlandse reacties op de evolutieleer 1860-1875: een terreinverkenning"*, in: Bijdragen en Mededelingen betreffende de Geschiedenis der Nederlanden, 85 (1970), pp.261-314.
Hodge, M.J.S., *"England"*, in: Th.F. Glick (ed.). The comparative reception of Darwinism, (Austin, Tex./ London 1974), The University of Texas Press, pp.3-32.
Hoeven, J. van der, *"Over de opvolging en ontwikkeling der dierlijke bewerktuiging op de oppervlakte onzer planeet in de verschillende tijdperken van haar bestaan"*, in: album der Natuur (1858), pp.33-48.
Hull, D.L., *"Darwinism and historiography"*, in: Th.F. Glick (ed.). The comparative reception of Darwinism, (Austin, Tex./ London 1974), The University of Texas Press, pp.388-403.
Huxley, Th.H., *"Evolution and ethics"*, in: Evolution and Ethics and other essays, (New York 1896).
——, *"A liberal education and where to find it"*, in: Science and Education, (New York 1898).
Klönne, B.H., *Onze voorouders volgens de theorie van Darwin en het Darwinisme van Winkler.* ('s Hertogenbosch 1869), Henri Bogaerts.
Kuyper, A., *Het Calvinisme.* Zes Stone-lezingen in oktober 1898 te Princeton (N.J.) gehouden, (Amsterdam/ Pretoria 1898), Boekhandel vrhn Höveker en Wormser.
——, *Evolutie.* Rede bij de overdracht van het rectoraat aan de Vrije Universiteit, 20 oktober 1899, (Amsterdam/ Pretoria 1899), Boekhandel vrhn Höveker en Wormser.
——, *De gemeene gratie.* (Leiden 1902-1904), publisher unknown, three vols.
Leeds, A., *"'Darwinism' and 'Darwinian' evolutionism in the study of society and culture"*, in: Th.F. Glick (ed.). The comparative reception of Darwinism, (Austin, Tex./ London 1974), The University of Texas Press, pp.437-447.
Moorehead, A., *Darwin and the Beagle.* Harmondsworth, (Middlesex 1969), Penguin Books.
Multatuli (E. Douwes Dekker), *Volledige werken.* Garmt Stuiveling (red.), (Amsterdam 1950), G.A. van Oorschot, ten vols.
Oudemans, C.A.J.A., *Inwijdingsrede over de plantkunde beschouwd in hare trapsgewijze ontwikkeling van de vroegste tijden tot op heden.* (Utrecht/ Amsterdam 1860), C. van der Post Jr. en C.G. van der Post.
Paul, H.W., *"Religion and Darwinism. Varieties of Catholic reaction"*, in: Th.F. Glick (ed.). The comparative reception of Darwinism, (Austin, Tex./ London 1974), The University of Texas Press, pp.403-436.
Pickering, G., *Creative malady. Illness in the lives of Charles Darwin, Florence Nightingale, Mary Baker Eddy, Sigmund Freud, Marcel Proust, Elisabeth Barrett Browning.* (London 1974), George Allen and Unwin Ltd.
Smit, P., *"Houding en reactie van het katholieke volksdeel ten aanzien van de evolutie-gedachte"*, in: De identiteit van katholieke wetenschapsmensen, (Baarn 1980), Ambo, pp.223-241.
Vloten, J. van, *"De modern-kristelijke godsdienstleer en het Darwinisme naar Duitse geloofsbespiegeling"*, in: De Levensbode, 7 (1874), pp.432-445.
Winkler, T.C., *"Darwin, over het ontstaan der soorten"*, in: Wetenschappelijke Bladen, 2 (1860), pp.1-38.
——, *"Leven en ontwikkeling uit een geologisch oogpunt beschouwd"*, in: De Gids (1864), pp.218-245 en pp.436-462.
——, *"De leer van Darwin"*, in: De Gids (1867), pp.22-70.
Young, R.M., *Darwin's Metaphor: Nature's place in Victorian culture.* (Cambridge/ London/ New York/ New Rochelle/ Melbourne/ Sydney 1985), Cambridge University Press.

LITERARY THEORY

Barfield, O., *"The meaning of the word 'literal'"*, in: L.C. Knights en B. Cottle (eds.). Metaphor and symbol, (London 1960), Butterworth Scientific Publications, pp.48-57.

Barthes, R., *"L'ancienne rhétorique. Aide-mémoire"*, in: Communications, 16 (1970), pp.172-229.

Black, M., *Models and metaphors.* (Ithaca, N.Y. 1962), Cornell University Press

Booth, W.C., *The company we keep. An ethics of fiction.* (Berkeley/ Los Angelos/ London 1988), University of California Press.

Boyd, U.D., *The function of mimesis and its decline.* (Cambridge, Mass. 1968), Harvard University Press.

Bryant, D.C., *"Rhetoric: its function and scope"*, in: J. Schwartz en J.A. Rycenga (eds.). The province of rhetoric, (New York 1965), The Ronald Company, pp.3-63.

Bucher, Th., *"Die heutige Einschätzung der Metapher in der Philosophie"*, in: Tijdschrift voor Filosofie, 34 (1972), pp.704-760.

Cascardi, A.J., *"The place of language in philosophy, or, the uses of rhetoric"*, in: Philosophy and Rhetoric (1983), 16, pp.217-227.

Christie, J.R.R., *"Introduction: rhetoric and writing in early modern philosophy and science"*, in: The figural and the literal: Problems of language in the history of science and philosophy, 1630-1800, (Manchester 1987), Manchester University Press.

Cohen, J., *Structure du language poétique.* (Paris 1966), Flammarion.

Derrida, J., *"La mythologie blanche. La métaphore dans le texte philosophique"*, in: Marges de la philosophie, (Paris 1975), Les Editions de Minuit, pp.247-324.

Eco, U., *Das offene Kunstwerk.* (Frankfurt am Main 1972), Suhrkamp Verlag (1962).

Finocchiaro, M.A., *Galileo and the art of reasoning.* (Dordrecht/ London 1980), D. Reidel Publishing Company.

Gerhart, M. and A. Russell, *Metaphoric process. The creation of scientific and religious understanding.* With a foreword by Paul Ricoeur, (Fortworth 1984), Texas Christian University Press.

Gilbert, N., *"Referencing as persuasion"*, in: Social Studies of Science, 7 (1977), pp.113-122.

Gross, A.G., *The Rhetoric of Science.* (Cambridge 1990), Harvard University Press.

Hamilton, K.G., *The two harmonies. Poetry and prose in the seventeenth century.* (Oxford 1963), Clarendon Press.

Hess, P., *"Zum Toposbegriff in der Barockzeit"*, in: *Rhetorik. Ein internationales Jahrbuch*, 10 (1991), pp.71-88.

Howell, W.S., *"Renaissance rhetoric and modern rhetoric. A study in change"*, in: J. Schwartz en J.A. Rycenga (eds.), The province of rhetoric, (New York 1965), The Ronald Company, pp.292-308.

Ingarden, R., *Das literarische Kunstwerk.* (Tübingen 1960), Max Niemeyer Verlag.

—, *Vom Erkennen des literarischen Kunstwerks.* (Tübingen 1968), Max Niemeyer Verlag.

Iser, W., *Die Appellstruktur der Texte. Unbestimmtheit als Wirkungsbedingung literarischer Prosa.* (Konstanz 1971), Universitäts Verlag.

—, *Der implizite Leser.* (München 1972), Wilhelm Fink Verlag.

Kibĕdi Varga, A., *"De traditionele retorica in de moderne literatuurwetenschap"*, in: Wijsgerig Perspectief op Maatschappij en Wetenschap, 17 (1976-1977), pp.278-307.

Knights, L.C. and B. Cottle (eds.), *Metaphor and symbol.* (London 1960), Butterworth Scientific Publications.

Lakoff, G. and M. Johnson, *Metaphors we live by.* (Chicago 1980), University of Chicago Press.

Landheer, R. and A. van Santen, *"De metafoor in (meta)talig perspectief"*, in: Wijsgerig Perspectief op Maatschappij en Wetenschap, 24 (1983-1984), pp.202-209.

Lanham, R.A., *The motives of eloquence. Literary rhetoric in the Renaissance.* (New Haven/ London 1976), Yale University Press.

Louch, A.R., *"Review essay John R. Nelson, (ed.), The Rhetoric of the Human Sciences: Language and Argument in Scholarship and Public Affairs"*, in: History and Theory. Studies in the Philosophy of History, 28 (1989), pp.357-365, University of Wisconsin Press.

Luxemburg, J.van, M. Bal and W. van Westeyn, *Inleiding in de literatuurwetenschap.* (Muiderberg 1981), Coutinho.

Maatje, F.C., *Literatuurwetenschap. Grondslagen van een theorie van het literaire werk.* (Utrecht/ Bohn 1974), Scheltema en Holkema, derde herziene druk.
——, *Open plekken.* Inaugurele rede 1981, (Utrecht 1981).
McCloskey, D.N., *"The problem of audience in historical economics. Rhetorical thoughts on a text by Robert Fogel"*, in: History and Theory. Studies in the philosophy of history, 24 (1985), pp.1-23.
Mooy, J.J.A., *"Taaldaden en de retorika van het onbewuste"*, in: Wijsgerig Perspectief op Maatschappij en Wetenschap, 17 (1976-1977)4, pp.253-267.
——, *Tekst en lezer. Opstellen over algemene problemen van de literatuurstudie.* (Amsterdam 1979), Athenaeum - Polak & Van Gennep.
Myers, G., *Writing biology: Texts in the Social Construction of Scientific knowledge.* (Madison 1990), University of Wisconsin Press.
Nelson, J.R. a.o. (ed.), *The Rhetoric of the Human Sciences: Language and Argument in Scholarship and Public Affairs.* (Madison, Wisconsin 1987), University of Wisconsin Press.
Ong, W.J., *Ramus: method and the decay of dialogue.* (Cambridge, Mass. 1958), Harvard University Press.
——, *The presence of the word. Some prolegomena for cultural and religious history.* (New York 1970), Simon and Schuster (first edition 1967).
——, *Orality and Literary. The Techno-logizing of the Word.* (London/ New York/ Methuen 1982).
Perelman, Ch., *Retorica en argumentatie.* (Baarn 1979), Ambo. Translation of: L'empire rhétorique. Rhétorique et argumentation (1977).
——, *The new Rhetoric and the Humanities. Essays on Rhetoric and its Applications.* (Dordrecht/ Boston/ London 1979), D.Reidel Publishing Company.
Richards, L.A., *The philosophy of rhetoric.* (Oxford 1978), Oxford University Press (first edition 1936).
Ricoeur, P., *La métaphore vive.* (Paris 1975), Editions du Seuil.
Sacks, S., *On metaphor.* (Chicago/ London 1978), The University of Chicago Press.
Schipper, M., *Realisme. De illusie van werkelijkheid in literatuur.* (Assen 1979), Van Gorcum.
Schwartz, J. and J.A. Rycenga (ed.), *The province of rhetoric.* (New York 1965), The Ronald Company.
Turbayne, C.M., *The myth of metaphor, revised edition.* (Colombia, S.C. 1971), University of South Carolina Press.
Weaver, R., *"The spaciousness of old rhetoric"*, in: J. Schwartz en J.A. Rycenga (eds.). The province of rhetoric, (New York 1965), The Ronald Company, pp.275-291.
Weinrich, H., *"Wenn ihr die Fabel vertreibt"*, in: Information und Imagination. Vorträge der Bayerischen Akademie der schönen Künste, (München 1973), Piper, pp.61-81.
Wimsatt, W.K. and C. Brooks, *Literary criticism. A short history.* (New York 1957), Knopf.
IJsseling, S., *"Nietzsche en de rhetorica"*, in: Tijdschrift voor Filosofie, 35 (1973), pp.766-799.
——, *Retoriek en filosofie. Wat gebeurt er wanneer er gesproken wordt?* (Baarn 1975), Ambo.
——, *"Fenomenologie, hermeneutiek, retoriek. Over een retorische lectuur van filosofische teksten"*, in: Th. de Boer, A.J. Nijk, P. Ricoeur en S. IJsseling (red.). Fenomenologie en kritiek, (Assen 1981), Van Gorcum.
Zoest, A. van, *Waar gebeurd en toch gelogen. Over fictie en niet-fictie.* (Assen 1980), Van Gorcum/ Brugge, Uitgeverij Orion.

GENERAL INDEX